O. E. Sette

CALIFORNIA FISH AND GAME

"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

Volume 8 SACRAMENTO, JULY, 1922 Number 3

CONTENTS.

		Page
MIGRATING SALMON AT THE REDDING DAM	*E. A. McGregor*	141
RECORDS OF THE CAPTURE OF FUR SEALS ON LAND IN CALIFORNIA	*Edwin C. Starks*	155
OBSERVATIONS ON THE EGG YIELD OF KLAMATH RIVER KING SALMON	*E. A. McGregor*	161
THE FISHERIES OF CALIFORNIA AND THEIR CARE	*Will F. Thompson*	165
THE CATTLEMAN'S RIGHTS	*Roy M. Hagen*	177
POSTED PROPERTY AND A SOLUTION OF THE HUNTING PROBLEM	*Captain Frank Winch*	179
EDITORIALS		183
CONSERVATION IN OTHER STATES		190
FOREST SERVICE COOPERATION		191
REPORTS		193
Expenditures		193
Fishery Products		194
Violations		196
Seizures		196

MIGRATING SALMON AT THE REDDING DAM.

By E. A. McGregor.

In connection with a lawsuit brought by the Fish and Game Commission against the Anderson-Cottonwood Irrigation District, owing to the alleged stoppage of salmon migration by the Redding Dam (on the Sacramento River near Redding), the writer was delegated to conduct an investigation of the dam from the salmon standpoint. The following observations have been extracted from the writer's report on his findings at the Redding Dam with the thought that they might prove of interest to readers of California Fish and Game.

The period covered by the investigations was from September 14 to October 7, 1921, inclusive. During this time the flash-boards were nearly all in place so that the dam constituted about as much of a

19493

barrier as is ordinarily the case. It was ascertained, moreover, that this had been the approximate condition of the dam since the beginning of irrigation in the spring.

The Redding dam (Fig. 61) is constructed fundamentally of concrete, but carries a steel superstructure which in turn supports a system of flash-boards. In detail the dam construction is as follows: A continuous concrete base or apron extends from shore to shore completely across the river—running nearly north and south. The dimensions of this base are: Three feet thick by 26 feet wide by about 440 feet long. Rising above this apron (Fig. 62) are 67 concrete piers with a clearance between them of five feet six inches.

Nature of dam.

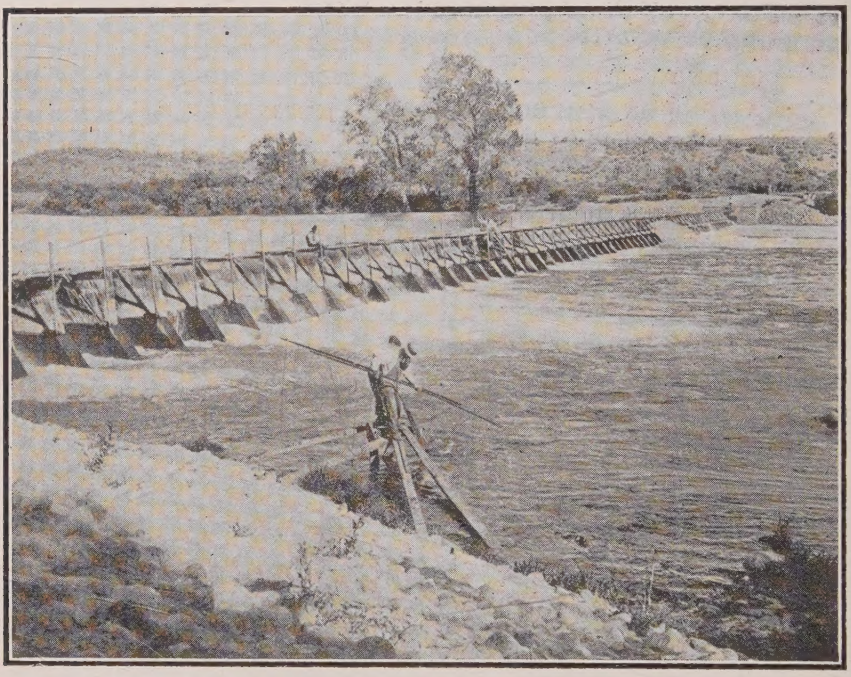

FIG. 61. View of dam from south shore looking northward. Flash-boards practically all in place. This condition exists from spring until about the middle of October.

Each pier is about 12 inches thick, rises slightly over 10 feet above the upper face of the apron, has a basal length of 24 feet and a top length of eight feet, resulting in angled buttresses both upstream and downstream. Each pier contains a deep cavity (see Fig. 63), about four inches wide and six feet deep which receives the folding superframe.

Each pier carries a superstructure of steel. This consists of a braced frame which hinges at the top of the upstream face of the pier. It is so constructed that it can be either elevated to carry additional flash-boards or dropped into the pier cavity so as to be flush with the top of the pier. The vertical height of this superstructure above the

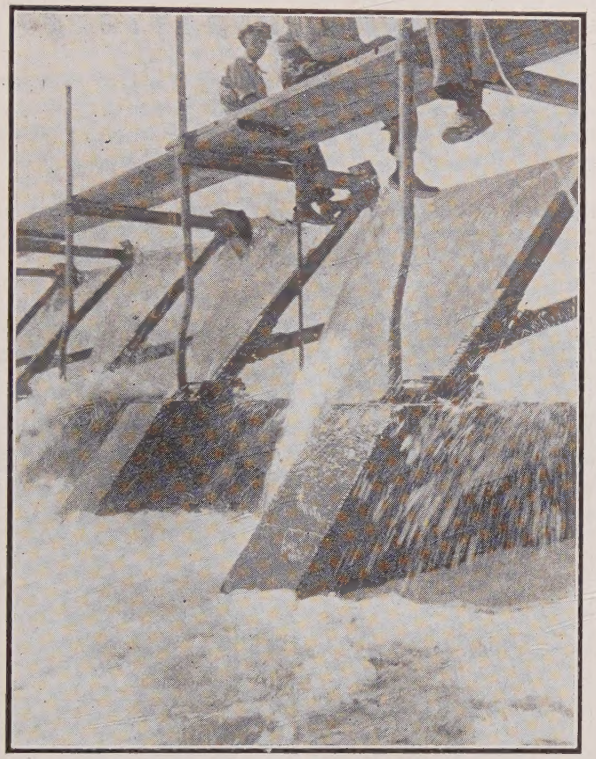

FIG. 62. Piers Nos. 2, 3 and 4 and ports Nos. 1, 2 and 3. Taken near north end of dam looking southwest. Boy spearing in pier pocket for trapped salmon.

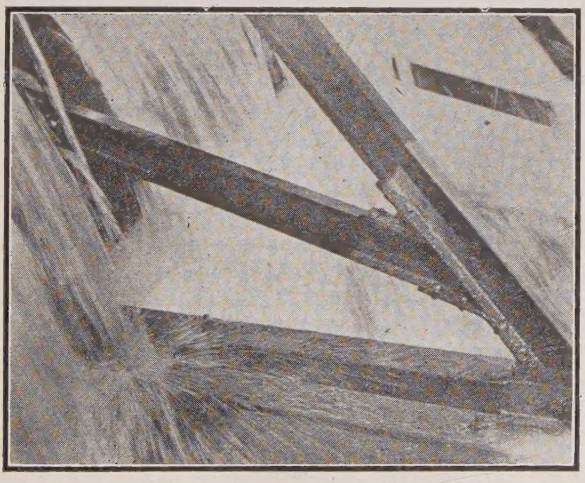

FIG. 63. Compartments 2 and 3, showing top of pier No. 2, with cavity so fatal to salmon.

concrete pier is approximately five feet six inches. Thus, the entire height of the dam crest above the basal apron is about fifteen feet eight inches.

Detailed condition of compartments.

At the time of our first visit to the dam, and continuously thereafter throughout the investigation, the specific arrangement of each of the 68 dam compartments was as follows:[1]

TABLE I.—Condition of Compartments During Investigation.

Compartment number	Boards removed	Inches of water above top board	Compartment number	Boards removed	Inches of water above top board
1	None	2	35	None	3
2	2	24	36	None	0
3	2	24	37	None	0
4	3	30	38	None	3
5	3	30	39	None	2
6	None	2	40	None	3
7	None	1	41	None	4
8	None	½	42	None	5
9	None	0	43	None	3
10	None	3	44	None	2
11	None	0	45	None	1
12	None	0	46	None	0
13	None	0	47	None	0
14	None	0	48	None	0
15	None	0	49	None	0
16	None	0	50	None	0
17	None	3	51	None	1
18	None	0	52	None	2
19	None	0	53	None	4
20	None	0	54	None	0
21	None	0	55	None	0
22	None	1	56	None	5
23	None	2	57	1	8
24	1	12	58	1	10
25	1	8	59	1	10
26	7*	66	60	2	16
27	7*	66	61	2	16
28	None	0	62	None	1
29	None	0	63	None	1
30	None	½	64	None	2
31	None	0	65	None	0
32	None	0	66	None	0
33	None	2	67	None	1
34	None	1	68	Part of 1	10

*Sections 26 and 27 comprise the spillway.

On one occasion a light rain raised the river level at the dam about two inches. With this one exception, the above table indicates the flow over the dam during our investigations. Only nine compartments had a foot or more of water passing over their respective crests. These were compartments numbers 2, 3, 4, 5, 24, 26, 27, 60 and 61. The remaining 59 compartments, for the most part, had only thin films of water passing over them and thus obviously precluded the slightest possibility of the passage of fish therethrough.

Compartments numbers 26 and 27 (see Fig. 64) constitute what the Anderson-Cottonwood irrigation authorities choose to term the "fish-way;" in these compartments all the flash-boards were out down to the pier level. Compartments numbers 2, 3, 4 and 5 are at the extreme northern end of the dam. They offer the best leaping possibilities and they will be discussed hereafter at greater length.

[1]We have arbitrarily numbered the compartments of the dam, commencing at the northern end, from 1 to 68, inclusive.

Method employed. The method adopted whereby specific data could be accumulated, capable of demonstrating beyond any doubt the ability or non-ability on the part of salmon to clear the various compartments of the dam in the course of their spawning migrations, was as follows: One compartment at a time was carefully watched for a period of 15 minutes; the total number of leaps and the number gaining the crest of the dam were noted in each period.

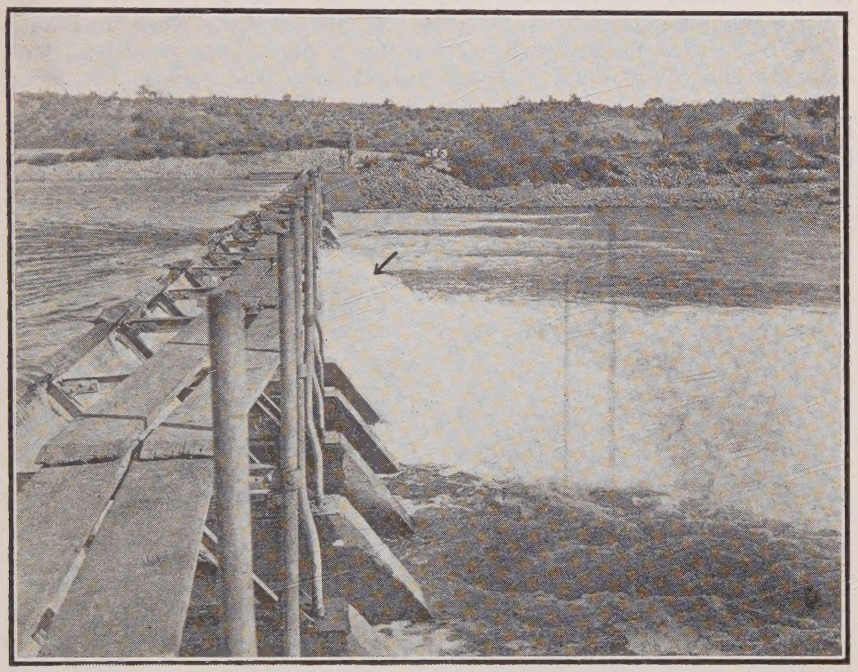

FIG. 64. Spillway from a point 35 feet to the southward. Camera about four feet above level of dam crest.

In all but the spillway—comprising compartments numbers 26 and 27—this method, from the first, proved entirely convincing and trustworthy. However, there were those who maintained that, owing to the depth of water passing through sections 26 and 27, it was possible for salmon to penetrate the down-rushing water without being detected by the eye of the observer. The writer realized that this contention might be employed by the dam authorities and sympathizers to the great embarassment of those trying to establish the case for the fishway.

Visibility through water. Rather early in the investigation the writer discovered that during a portion of the forenoon—from about 9 a.m. to about 11 a.m.—the sun's rays struck the crest of the dam at such an angle as to sufficiently illuminate the topmost remaining plank at the bottom of the spillway. During this interval, with one's back toward the sun, there were no confusing reflections or refractions from the upstream (western) direction, and

the visibility to the bottom under these conditions was all that could be desired.

In other words, when one took advantage of the most favorable conditions, *it was possible to be certain* for every compartment, *whether or not salmon were passing* to the still water above the crest of the dam.

Use of water-glass.

Through conferences with Messrs. Shebley, Scofield, Duke, Doney, Lambson (of the Commission), and Rich and Hancock (of the U. S. Bureau of Fisheries), who visited the Redding dam during our investigations, there crystallized the idea of constructing a water-glass or hydroscope. Such a device was perfected by cementing a plain auto headlight lens into the end of an eight-inch galvanized sheet-iron casing. Tests of

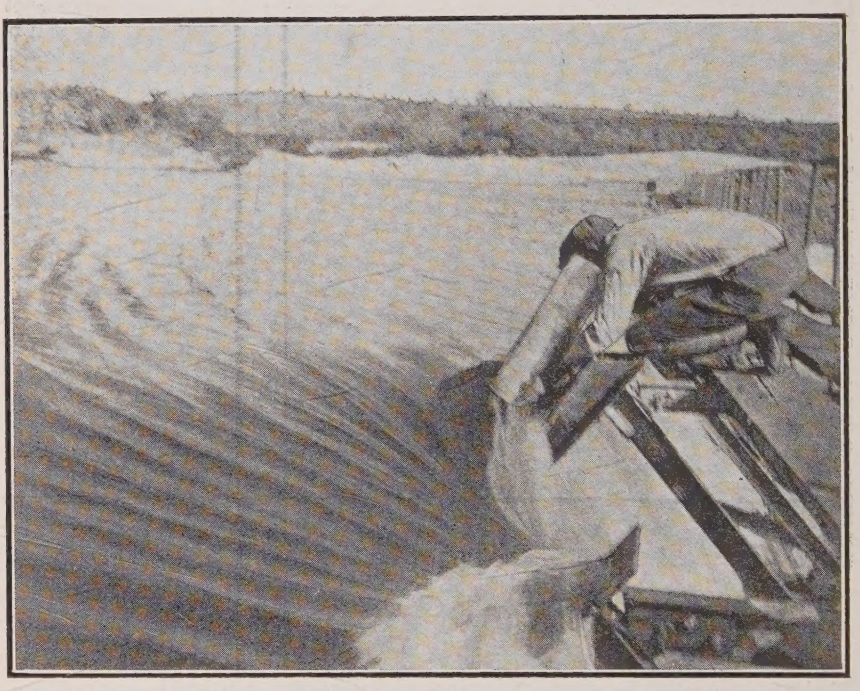

FIG. 65. View at spillway looking northward. Observer peering through six feet of water by means of water-glass.

this device at the so-called "fishway" were highly satisfactory. Through the employment of the hydroscope—especially in the forenoon—the visibility through the entire depth of the spillway (see Fig. 65) became excellent. *No passing salmon during the use of the water-glass could escape detection.*

Detailed data on leaps.

The following table has been prepared from the accumulated data secured in connection with the numerous fifteen-minute counts. It summarizes the information concerning the leaping of salmon at the dam:

TABLE II.—Summary of Observed Salmon Leaps.

Section numbers	Number of 15-minute observations	Total leaps observed	Average leaps per 15-minute observation	Number of fish clearing dam	Estimated leaps in 12 daylight hours
1	3	8	2.66	0	127.68
2	59	1,644	27.86	9	1,337.28
(2 and 3)*	(2)	(65)	(32.50)	0	
3	36	195	5.42	1	260.16
4	3	1	.33	0	16.00
(4 and 5)*	(2)	(6)	(3.00)	0	
5	7	13	1.86	0	89.28
24	1	4	4.00	0	192.00
25	2	3	1.50	0	72.00
(25 and 26)*	(1)	(4)	(4.00)	0	
26	9	27	3.00	0	144.00
(26 and 27)*	(13)	(90)	(6.92)	0	
27	12	54	4.50	0	216.00
(27 and 28)*	(1)	(8)	(8.00)	0	
30	1	0	0	0	0
40	1	0	0	0	0
41	1	0	0	0	0
47	1	0	0	0	0
60	3	0	0	0	0
61	2	0	0	0	0
67	2	0	0	0	0
68	3	10	3.33	0	160.00
Totals	165	2,132		10	

Leaps per twelve-hour day, 2,614.40. Per cent clearing dam, .469.

*On a few occasions the observer watched two compartments at a time.

From the foregoing table it will be seen that in the course of 165 fifteen-minute observations 2132 leaps were observed. Out of this number only 10 fish managed to gain the crest of the dam. This yields a percentage of .469 (less than half of one per cent, of successful leaps. Based on our data, it is computed that approximately 2614 salmon leaps occurred each twelve-hour day during the course of our observations.[1] In other words, our data reveals that in the course of a twelve-hour day (daybreak to dusk) an average of 2614 salmon attempted to leap the dam; of these 12 (.47%) succeeded, while 2602 (99.53%) failed.

Night leaping doubtful.

From actual nocturnal observations, and from the declarations of fishermen, it seems established that very little, if any, leaping occurs at night. In an hour's close watch on a very bright moonlight night, not an attempted leap was seen. Furthermore, it is said that trapped fish are rarely taken from the pier pockets immediately after daybreak, which fact confirms the above contention. This, if true, would confine our considerations to the diurnal activities of salmon.[2]

[1]This figure represents a conservative estimate since we have assumed that 58 compartments are entirely unattractive for leaping.

[2]The nonoccurrence of salmon leaping at night has been corroborated by the declarations of the workers at the racks.

So far as our observations have progressed, we believe we may state that it is strongly indicated that all salmon individuals that were seen to gain the crest of the dam were small males, commonly called "grilse." They are spry and muscular (mostly between two and six pounds) and are unencumbered with surplus weight. The apparent failure of females to pass the dam is a point which deserves serious consideration in connection with normal upstream spawning activities. Furthermore, one can not help but note that the females, after "fighting" the dam, fall comparatively easy prey to the expert spearing fishermen.

Females barred.

By the very nature of the dam, constituting as it does an almost unsurmountable barrier, there is a resulting piling up or concentrating of salmon in the river immediately below the dam. This naturally facilitates fishing operations at this point on the river. The common methods of capture observed during the investigation were, namely, spearing, use of grabhook, set line, rod and reel and dip nets.

Dam barrier aids capture.

From the evidence adduced, the spearers (see Fig. 61) land about one out of five salmon hit. It is claimed—and it seems probable—that those injured and escaping have slight chance of recovery in the fungus-laden fresh water. The grabhooks are, like the spears, operated directly from the dam. In addition, they are used to extract the salmon which frequently fall into the cavities in the concrete piers. Spearers and others frequently employ setlines as a supplement to their other activities. Certain parties were observed using dip nets to trap the salmon as they fell back after attempted leaps. Tourists and sportsmen operated daily with rod and reel. Fishermen of all types have come to know that salmon concentrate below the dam during the period that the flash-boards are in place.

To the casual observer, the cruel battering against the dam is a more obvious realization than is the failure to gain the crest. As will be discussed later, the majority of the salmon fail to leap to the best possible advantage. Owing to the impact of the excessive drop of the water, much foam at the base obstructs the vision. As a result, the path of the leap is usually at an angle to the perpendicular to the crest (*i. e.*, to right or left of a direct upstream line). This results in innumerable cases of individuals crashing against the cement piers and the steel superstructure. We have seen salmon float helplessly following these collisions. Stunned fish occasionally strand on the pebble bar below the northern end of the dam.

Injuries sustained.

A more spectacular type of accident occurs when leaping fish fall into the cavities in the piers (see Fig. 63). In some of these the water escapes through holes below, too small, however, to permit the escape of the trapped salmon. All salmon falling into these pockets are doomed. Every day dozens of fish are extracted from these holes—many of them badly battered from their desperate endeavors in attempting to escape.

Pier holes are traps.

It is impossible to estimate the percentage of salmon which are destroyed through contact with the dam structures. It must be very heavy, however, and many observers believe that the majority of the migrating salmon continue to "fight" the dam until they perish.

A type of fungous disease is quite prevalent among salmon in the river, and it is probable that this disease is enabled, in part, to infect the fish through the abrasions caused by battering against the dam. We have seen badly infested salmon drifting weakly downstream above the dam, which fact indicates the influence the dam may exert on a certain number of individuals even after they have luckily leaped it.

Fungous disease.

The authorities in charge of the dam have selected compartments numbers 26 and 27 for the location of the spillway (see Fig. 64). With no little humor, they speak of it as the "fishway." From side to side this gap in the dam[1] measures 12 feet. The flash-boards are removed down to the level of the top of the concrete piers, so that nearly six feet of water passes over the topmost remaining plank. It is necessary to behold this spillway to gain a clear comprehension of its nature. Through the gap tumbles a crashing deluge. (This is true even at the low stage of the river.) Upon reaching the level of the river below, the torrent churns and boils in a fierce madness that resents resistance. Within a large fan-shaped zone adjacent to the base of the spillway there is a continual seething chaos.

Concerning the spillway.

We have observed, and without surprise, that salmon do not often venture into this maelstrom. The great majority seem instinctively to avoid it. When rarely, an individual "stumbles" into the "boil," it is tossed about in a nearly helpless condition. The few leaps that are attempted therefrom are always abortive. The direction of these occasional leaps is about as likely to be away from the dam as toward it. The salmon appear instinctively to realize that they possess slight chance of leaping effectively from this spot.

Wary of spillway.

During the many hours spent on the dam, the total recorded number of well-directed leaps at compartments numbers 26 and 27 (the spillway) have been few indeed. Most such attempts carried the individuals but two or three feet above the stream level and, upon contact with the spillway falls, were dashed hopelessly back again into the seething "boil" from which they rose.

We are reliably informed that the spillway was located where it is because of the fact that a large mass of stone occurs on the river bed immediately below this point. Whether this was placed there, or whether it is a natural dike is not established. This aggravates the turmoil below the spillway, causing an unfavorable shallowness there, and helps to defeat the intended purpose of the miscalled "fishway." It prevents erosion and back cutting which obviously explains why the dam officials chose this location for the spillway.

Conditions bad below spillway.

By means of direct double observations, it was possible to establish positively that salmon can not and do not gain the crest of the dam at the spillway. These observations were conducted as follows. Our assistant watched carefully for attempted leaps at the base of the spillway falls for a certain period (usually 15 minutes). During this same interval the writer, by the use of the water-glass, gazed through the six feet of

Water-glass at spillway.

[1]Obviously this gap in the dam functions as a spillway only when the flash-boards in the remaining compartments are in place.

water to the topmost remaining flash-board beneath the spillway. So perfect was the visibility when the hydroscope was employed that the passage of the smallest migrating fish could not escape detection.

An observation which contributes to prove that the spillway region is unfrequented by salmon, is the fact that the seasoned old spearers and other fishermen never operate at that portion of the dam (which they naturally would if the spillway functioned as an avenue of migration, as claimed by the dam authorities).

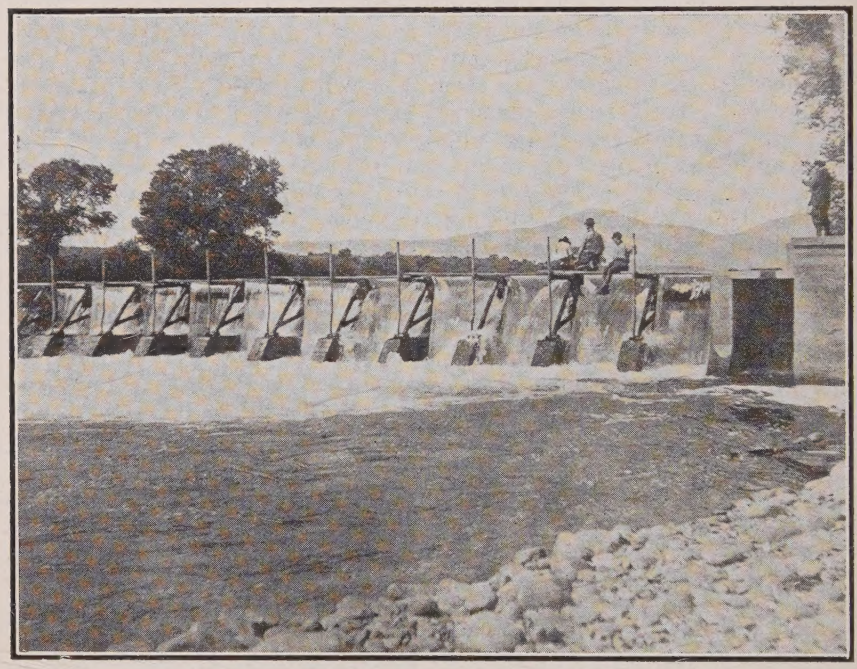

FIG. 66. North end of dam from down stream; camera directed up stream. Figures grouped above compartment No. 2, at which point most leaping occurs.

Most leaping at section number 2.

As has been previously recorded, compartment number 2 (at northern end of dam—(see Fig. 66) is conspicuously the point on the dam most preferred by the salmon for attempted leaps. As revealed in a following table, out of a total of 2132 observed leaps, 1644 of them took place at section number 2. This represents 77.1 per cent of all leaps recorded during the investigation. Clearly, there must be an explanation for this striking phenomenon.

One of the laws of hydraulics of a stream is, namely, that the flow is strongest at the center and weakest at the margins of the stream. Also, as the depth increases the current decreases, and vice versa. Now, compartment number 2, obviously, is at the margin of the river, and is immediately above the largest and deepest pool adjacent to the dam. It follows, then, from the above-quoted law, that the quietest water along the dam is to be found at this particular point. Moreover, the flash-boards of number 2 were so arranged that a vertical depth of 24 inches of water was spilling thereover. As will be developed later, it is true that newly arriving salmon "prospect" along the base of the

dam in an endeavor to locate the most propitious point for leaping. By elimination they ultimately select compartment number 2 as the point at which to center their efforts.

Too much emphasis can not be placed on our contentions that the above spot (compartment number 2 and vicinity) is the natural and most logical location for the construction of the proposed fishway (provided the topography of the river bed continues fundamentally as when our observations were made).

a. *Reconnoiter.* From our rather intimate studies of leaping salmon, we are convinced that the great majority of individuals examine the "falls" prior to attempting the leap. They are seen to swim directly into the base of the falling water and, returning, pass through it again. The theory suggests itself to us that some instinct or special sense enables the salmon to gauge the height and amount of water passing over the crest, by means of the impact experienced in these passages through the falls.[1] At the same time the individual ascertains, for the moment, the re'ative location of the obstacle to be cleared.

Salmon leaps analyzed.

b. *Initial leap.* When a salmon is thus observed cutting and recutting the base of the falls, it may be assumed with considerable certainty that the attempted leap is imminently at hand. After sufficient lapse of time to permit the individual to dive down to a chosen starting point, and to shoot upward to the surface, the recent "prospector" almost invariably essays its first leap (this applies only to compartments where conditions are at least remotely favorable.) Owing to the artificial nature of the Redding dam (and to its non-existence in the phylogeny of the Sacramento race), the necessary effort is always under gauged in the case of the initial leap. The result is, at best, a four- or five-foot jump.

c. *Subsequent efforts.* The delay or non-de'ay of the later leaps depends on the success of the initial attempt. Individuals that strike the falls in a well directed manner immediately "gather themselves together" and repeat the leap with very little delay—often within 10 or 15 seconds. In cases, however, (and they are very frequent) where the first leap results in contact with the cement piers, steel superstructure, or the downstream face of the flash-boards, the individual's "spirit" seems to be "broken," for the time, and these fish are not observed to leap again soon. It should be added that an individual usually advances with each succeeding leap until either it gains the crest (rare indeed) or wears itself out.

d. *Point of starting leap.* Owing to the structure of the dam, with the downstream projecting piers, the salmon are greatly handicapped in their leaping. As they dart upward through the water, in the momentum gaining portion of the leap, the submerged buttresses of the piers constitute, no doubt, a vital factor in determining the point of emergence from the water. Probably the majority of the leaps start from points below (*i. e.* downstream) the eastern margin of the buttresses. This necessitates an aerial leap of about eight and one-half feet in height and approximately eight feet in horizontal distance in order to gain the crest of the dam. As a matter of fact, the vast majority of leaps thus started become abortive since the trajectory of

[1]This may be one of the functions of the lateral line organs.

the fish meets the falling sheet of water at a right or descending angle.

e. *Direction of leap.* As has been previous'y recorded, the majority of the leaps are misdirected. The irregular outline of the dam—consisting of alternating buttresses and ports—is the factor most to blame, we believe, for this inaccuracy in leaping. This condition in no sense simulates the contour of a natural waterfall, and the salmon's instincts are unavailing as against the artificial barrier. The abundant presence of foam and "white water" work to aggravate this malcondition by obscuring the real location of the crest of the dam, which might otherwise be gauged through the fish's optic sense. Probably other senses, such as "direction of flow," "source of impact," and sound, are the chief guiding agencies.

Under a previous heading we have described the common occurrence of salmon diving headfirst into the piers and superstructure as a result of misdirected leaps.

f. *Height attained.* The great majority of the jumps are surprisingly futile. We would roughly estimate that the average height of all observed leaps is not in excess of three feet. Some individuals elevate themselves less than a foot above the water level. On the other hand, some remarkable leaps have been witnessed. Two small salmon (probably "grilse") were seen to strike against the plank footway which is about two inches higher than the crest of the dam. Another individual, whose leap was successful, actually leaped a trifle beyond the crest and struck the smooth water a few inches upstream. Such leaps as the two last mentioned, however, are so rare as to be hardly deserving of consideration.

g. *Successful leaps analyzed.* There seem to be two types of successful leaps. In one case the salmon leaps high and squarely toward the crest. The instant the fish cuts the water (immediately below the crest) it forges straight ahead through the utmost application of its swimming power. Usually in such cases the salmon is almost at a "standstill" at the moment of passing the crest.

In the other type of successful leap, the fish may not soar quite so high, but cuts into the falls at an angle toward the side of the compartment. It appears to flex or arch the body in such a way that the flow of the "falls" has a tendency to force the individual sidewise and upward—like a boat "quartering" against a current. Probably the initial momentum operates to assist in the ascent through the falling water.

In either case, upon gaining the crest, the fortunate individual dives quickly downward toward the zone of least flow.

Miscellaneous observations.

a. *Arrival of a fresh school.* The arrival of a new school at the dam is quickly detectable. The individuals are much more active and they all seem to be "possessed" to leap at the same time, so that there is a condition at the dam approaching congestion. At such times, before the school has become badly dispersed through "fighting" the dam, it is a common sight to see the salmon leaping simultaneously in pairs. Just what they may gain by this phenomenon is difficult to see. The leaping pairs are frequently of the same sex.

b. *Fishermen's testimony.* Several fishermen, of whom we solicited opinions relative to the passage of salmon over the Redding dam,

were in complete accord with Jean Barion—a pioneer fisherman of this region. In reply he asked: "Why would we journey miles down the river from our homes to fish at the dam if we could get fish up where we belong?" Jean's sentiment is a dramatic refutation of those who dare to claim that the dam is no serious barrier to the upstream movement of salmon.

The writer has repeatedly asked upstream residents what they knew concerning the prevalence of salmon above the dam—especially during the months when the flash-boards are in place. All have been agreed that they have become extermely scarce since the erection of the dam. Several keen observers informed me that they had seen no sign of mature salmon during the summer months.

c. *Net experiments.* With the idea of attempting to establish beyond doubt the precise number of salmon clearing a particular portion of the dam in a given time, the use of a net suggested itself. Accordingly, Mr. Wm. Shebley, Superintendent of Hatcheries, upon request, dispatched to the scene about 30 feet of small mesh seine. This was placed, by various means, just above the crest of the dam. Unfortunately the force of the current was such that the lead line was invariably swept down over the dam with the result that the normal activities of the fish were interfered with. In the course of these trials the net was rather badly torn and we were forced to abandon this phase of the investigation.

It appears that the only practical way of applying this idea would be to stretch a seine entirely across the river at a safe distance above the falls. Mr. Shebley stated that he had once figured on constructing a rack across the stream from shore to shore above the dam, but that lack of available funds had prevented the test.

We hasten to state, however, that measures so heroic as these are not needed to convince scientific observers that only a negligible percentage of the salmon run is able to pass the Redding dam. A test of the above sort would no doubt be convincing to open-minded persons, but probably not to the type of men who oppose fishways in general.

d. *Oxygen stimulation and leaping.* While we are recording observations independently arrived at, it may not be amiss to include the following theory. As we know, fishes breathe by means of the presence of free oxygen in the water. Immediately below a dam or falls there obviously is a superabundance of air—and consequently free oxygen—carried in the "white water." In the wonderful balance of Nature it may be that fish derive their marvelous leaping energy from the temporary stimulation exerted by means of this excess of oxygen *to be found in the very portions of the streams* where piscean energy is vitally needed.[1]

[1]In reading my manuscript, two authorities have criticized the above theory. They contend that physiologists have demonstrated that the red corpuscles of the blood are definitely limited in the amount of oxygen which can be taken up, and that this fact invalidates my theory. I am not ready to admit that my critics are correct. As a first counter argument I propose the possibility that in the more sluggish portions of rivers salmon may not secure the maximum supply of oxygen that is desirable from the standpoint of maximum energy, whereas, on the other hand, this optimum condition *is* found at points where the stream is greatly agitated. In other words, is it not possible that mature migrating salmon may secure such supplies of oxygen immediately below falls as to suffice for the utmost demand on their energy, whereas this condition is not elsewhere encountered? My other postulate is, namely, that the imminent need of leaping power, with the resulting physical exertions that obtain at a stream barrier, call into being the formation of a higher corpuscle content in the blood. Obviously this would have the effect of imparting to the blood an increased oxygen-carrying coefficient. Surely, the burden of proof falls on those who make the claim that piscean activity does not respond to a changing supply of available free oxygen.

In a recent paper by Gilbert and O'Malley[1] relative to salmon of the Yukon River they present a table designated to indicate the rate of travel of the spawning run up the Yukon River. Based on their data the first 279 miles up from the mouth was made at an average rate of 34.9 miles per day; the next 276 miles at 46 miles per day; the next 296 miles at 74 miles per day; the next 376 miles at 47 miles per day; and the remaining intervening 277 miles to Dawson at the average rate of 92.3 miles per day. With the exception of the 376-mile stretch, there was a very obvious increase in the rate of travel over the 1504 miles as the salmon progresses toward the headwaters of the Yukon. The final 277 miles (below Dawson) being covered at the fastest rate of the several legs of the journey. This phenomenon further substantiates the above presented theory of the influence of oxygenation upon the fluvial activities of mature salmon, since the Yukon no doubt, like other streams, is more broken and interrupted in the upper reaches.[2]

We will refrain from using a formal summary and merely recapitulate to the extent of stating that a careful investigation of the Redding dam—covering a period of over three weeks—has positively established the fact that said dam (as it was during our observations) constitutes an almost perfect barrier against the upstream migration of salmon to their natural spawning beds. Careful computation indicates that, during the period from September 14 to October 7, 1921, inclusive, 99.53 per cent of the salmon which arrive at the foot of the dam are unable to pass it, and are thus denied the possibility of propagating their kind.

Whether it is possible that a portion of this barred horde may persist below the dam until the flashboards are removed at the close of the irrigation season, is not established. However, between fishermen, mechanical injury at the dam, precocious spawning, infectious diseases and other inimical agencies, the mortality is shockingly severe.

The officials of the Anderson-Cottonwood Irrigation District probably took the position that the matter of serving their patrons with irrigation water is of more vital concern than is the migration of salmon which supplies the upper Sacramento system. Fortunately, in the case of a river obstruction of the height of the Redding dam, the construction of a practicable fishway is not a difficult matter. The Fish and Game Commission has prepared plans for such a fishway and the commission intends to see that adequate provisions are installed at an early date in order that the salmon run may become reestablished as it has been since time immemorial.

[1]Investigation of the Salmon Fisheries of the Yukon River, U. S. Bureau of Fisheries, Document No. 909a.

[2]In the published works of Wells, Shelford, Allee and others on the reaction of fishes to various concentrations of oxygen and carbon dioxide, it develops that the oxygen content varies from 1 to 15 c.c. per liter and the carbon dioxide from —7 c.c. to 47.8 c.c. per liter under diverse natural conditions. Wells states that "the lower end of a 50-foot pool in a small creek may contain 5 c.c. per liter of oxygen less than the water of the upper end." These workers also have shown that fishes often react in behavior to an oxygen concentration as high as between .7 and 1 c.c. per liter, and are even more susceptible to carbon dioxide. They show that oxygen in large amounts (10 c.c. per liter) combats the detrimental effect of high carbon dioxide (50 c.c. per liter).

RECORDS OF THE CAPTURE OF FUR SEALS ON LAND IN CALIFORNIA.

By Edwin C. Starks.

Of the many accounts of the taking of fur seals on land in California—especially on the outlying islands, none of them tells whether the seals were the Alaska fur seal, *Callorhinus alascanus,* or the Guadalupe Island fur seal, *Arctocephalus townsendi.* The reason for such neglect is that when most of the records were made it was not known that the Guadalupe fur seal was quite different from the Alaska fur seal.

Dr. C. Hart Merriam described the Guadalupe fur seal in 1897 from some weather-worn skulls picked up on the beach at Guadalupe Island by Dr. C. H. Townsend. Pictures of the type skull are here reproduced. Dr. Merriam wrote: "The species seems doomed to speedy extermination, and, so far as known, no museum in the world has a single specimen." Only 15 or 20 years before that time there were thousands of fur seals on Guadalupe Island, but within a space of a very few years sealers had almost completely exterminated them. One or two expeditions have since attempted to obtain specimens, and though a very few have been seen none has been secured. This island appears to have been the scene of the last stand of this species of fur seal, which was probably the species that was at one time abundant on the outlying islands of our coast.

The Alaska fur seal migrates every year from its breeding ground on the Pribilof Islands in Bering Sea southward to some point off the California coast. This point is variously stated from "off the coast of northern California" to "the latitude of southern California." With the exception given below of the Alaska fur seal, that was found on the Oregon coast, there is no evidence that they ever come to land.

Now all of the animals of this group have habits that are as nearly unchanging as habits conceivably can be, and we can feel reasonably sure that if the Alaska fur seals ever had the habit of landing during their migration they would still do so. On the other hand, the fact that the Guadalupe fur seal is practically extinct is an irrefutable reason to explain the present absence of that animal on our coast, where once it may have been abundant. What fur seal was found on the Farallones, is perhaps more problematical than what seal was found on the Santa Barbara Islands, which are more nearly in the same faunal zone as Guadalupe Island.

Dr. C. H. Townsend (Rept. Fur Seal Invest. 1896–7. Vol. III, p. 268) says: "From the history of the smaller seal rookeries of the Pacific Ocean, it would seem that the fur seal could not be driven away to new islands, but stupidly lingers about its ancient haunts until extermination overtakes it." Though the Farallones may not have been a rookery (breeding place), they still were an "ancient haunt" of some form of fur seal. If the above trait can be relied upon it seems to indicate that the seal that inhabited them was the exterminated species, in other words, the Guadalupe fur seal.

On the other hand, perhaps the only record that we have of the landing on our coast of a fur seal of which the species is definitely known, is of an immature male Alaska fur seal that came ashore on

the Oregon coast, as recently recorded by the Journal of Mammology (Nov., 1921). It, of course, may have been sick.

As recorded by Bancroft* (XIX Hist. Calif. II 1801 to 1824) William Gale, captain's clerk of the ship Albatross, in a voyage along the California coast in 1809 to 1812, gives many items in his journal as to sea otter and seal fishing. In July, 1810, Gale was left on the Farallone Islands with seven men. Here he found two other bands of men that had been left a short time before from other ships, apparently

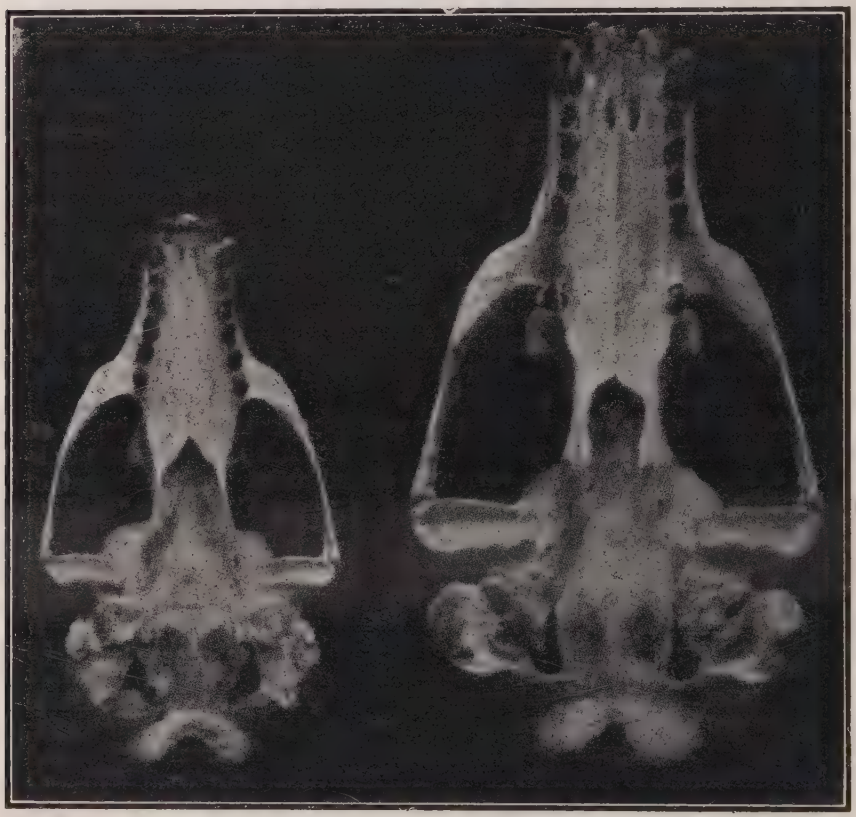

FIG. 67. Skulls of California (smaller) and Steller's sea lions. Note the wide space between the last molar tooth and the next one in Steller's sea lion. Both species have much longer muzzles than the fur seals.

of the same ownership and interests as the Albatross. By December, when the Farallone party was communicated with, they had taken 30,000 seal skins. In three years they took as follows:

1810, 33,740 skins; 1811, 21,153 skins; 1812, 18,509 skins; total for Farallones, 73,402 skins.

There is nothing in the report to indicate that these seals were not taken at sea, in which case they might have been of the Alaska migrating herd. But the time of the year at which they were taken would prove conclusively that they could not have been Alaska fur seals. It will be noted that Gale landed on the Farallones in July

*In a footnote Bancroft quotes that Capt. B. Smith with a party took 130,000 fur seals on the Farallones in two years, beginning 1808.

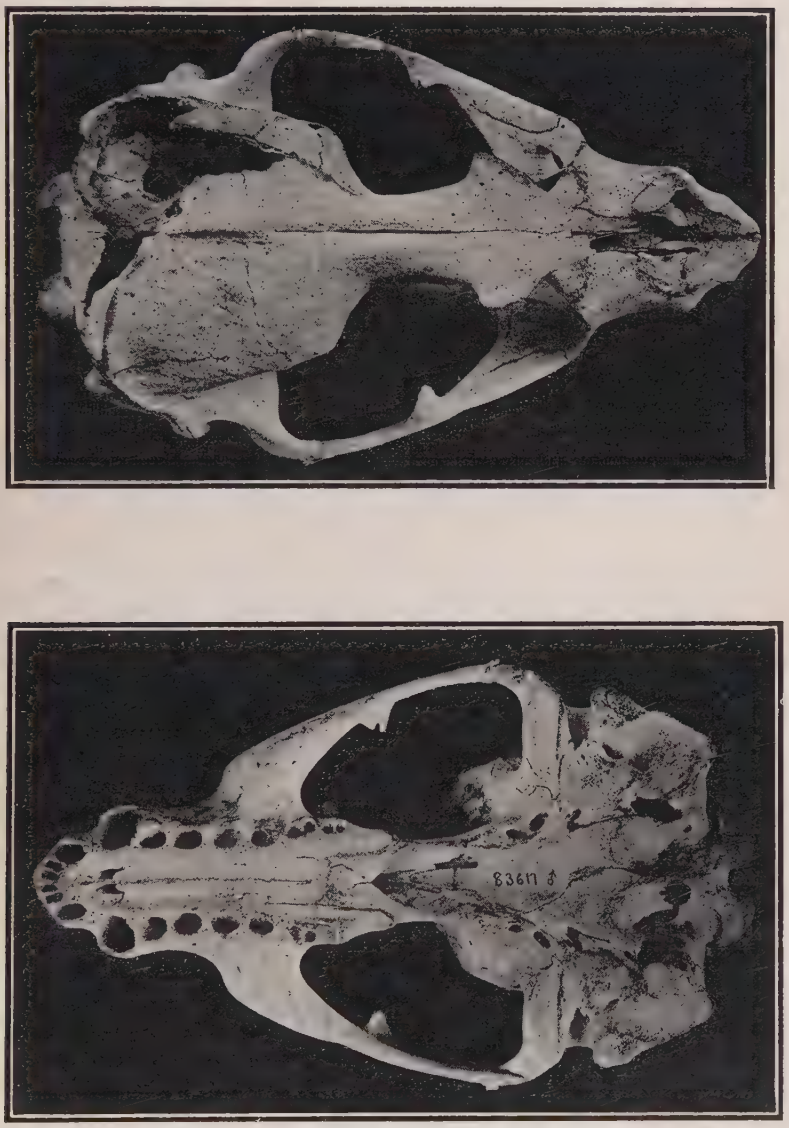

FIG. 68. Dorsal and ventral views of skull of Guadalupe fur seal. Photograph of type specimen in U. S. National Museum. (No. 83617.) Note the long narrow space between the rows of teeth and the short muzzle, as compared with the sea lions.

and by December had taken 30,000 skins. The Alaska fur seals appear off the coast about the middle of December. December 10 is the earliest date that one has been taken. Sealing at sea in California is continued through April, by which time the seals have got farther north. Gale took for the year 33,740 skins, so less than 4000 were taken after December, which would have been the only possible time the Alaska fur seal could have been obtained.

Bancroft further records (same volume, p. 633): "From 1812 to 1840 the Russians kept up an establishment at the Farallones as well as at Ross. The object at first was to secure fur seals, 1200 to 1500 skins being taken annually for five or six years, though Winship, Gale, Smith, and other Americans had taken the cream of this natural wealth a few years earlier. After 1818 the seals diminished rapidly until only 200 or 300 per year could be caught."

Sealing seems to have been resumed profitably in 1824. In G. Brown Goode's "Fisheries and Fishery Industries of the United States" (Sec. V, Vol. II, p. 357 footnote) is given a table of the number of fur seals taken on the Farallones for the years from 1824 to 1833. In the first year over a thousand were taken, but the number was less than 500 for the next year, and decreases gradually to 54 at the last year. The steady decrease of this and of the Gale operations is significant, for it would scarcely occur during this length of time if the record were of seals taken off the island in the open sea. In other words, shore sealing would probably indicate a local herd, while pelagic sealing would more probably have to do with the great migrating herd of Alaska fur seals from the north that could not be so easily or quickly depleted. The rapid recovery between each series of years of consecutive sealing could be explained, theoretically at least, to natural breeding. Without considering the natural forces of destruction, 100 females could increase in five years to 1600. Just what the natural loss would be if they were left undisturbed is problematical, of course. These figures are given only to show that the rapid increase is not too great to be explained by breeding only, though it was probably due to other causes as well, such as a migration from island to island.

In the same footnote is the statement that in 1878 a few hundred fur seals were taken by sea lion hunters on Santa Barbara and Guadalupe islands. The former locality is the only one of interest, for there is no doubt as to the seals of the other locality.

From "Life in California," by A. Robinson, published in 1846, but written from notes made from 1828 to about 1842, I copy this: "Finally we saw the rocks called the Farallones. We soon passed the largest and southermost one, which was still occupied by the Russians; and could distinctly perceive among the huts ten or twelve persons, who were living there for the purpose of catching fur seal, which were so abundant in former years, that my friend G——— assured me he had assisted in collecting during one season over 80,000 skins from this same island." Farther on in the book "friend G———" pointed out the place on the island where fur seals were clubbed. This was in 1833, and "many years had passed." The extravagant number stated, which far exceeds other records for the Farallones of

this date more or less invalidates this account. I quote it because it is the only one that indicates how and where the seals were taken, or that they were taken on land and not at sea.

From "Natural Wealth of California," by T. F. Cronise, published in 1868, I copy the following: "There is a species of fur seal (yet undetermined scientifically) which visits the Farallones, and other islands of our coast, in small numbers." The author recognizes the sea lion for he states that it is of little value.

Captain C. M. Scammon, in "Marine Mammals of the Northwestern Coast of North America," in 1874, writes: "On the coast of California, many beaches were found fronting gullies, where (fur) seals in large numbers formerly gathered; and as they there had plenty of ground to retreat upon, the sealers sometimes drove them far enough back to make sure of the whole herd, or that portion of them the skins of which were desirable."

Mr. Frank Stevens in his book on "California Mammals," says: "When California was first settled by the whites, fur seals were occasionally found on some of the islands, and at a few localities on the mainland, but whether these were of this (Alaska fur seal) or of the following species (Guadalupe fur seal) is not now known."

Dr. C. H. Townsend, in "Report of Fur Seal Investigations" (1896–1897, Vol. III, p. 268) in referring to Guadalupe fur seal says: "It is reported that five seals were taken on Richardson's Rock, off San Miguel Island, one of the Santa Barbara group, in 1890."

In 1902, when I was studying sea lions of Santa Cruz Island, I was told by Capt. Roselyn Vasquez, a man who had considerable experience as a sealer in Alaska, and in capturing sea lions for zoological gardens, that the year before three fur seals had been killed on the island. This was later repeated to me by a man in Santa Barbara, where, if I remember correctly, the skins were sold.

Dr. Gray received at the British Museum from Monterey in 1859 the skin of a fur seal. Dr. Allen (North American Pinnipeds) naturally referred this to the Alaska fur seal, the Guadalupe seal not having been described at that time. Which of these two forms it is remains unknown, and probably will remain unknown until the differences between them in pelage are better known. The skull that accompanied the skin did not belong to it.

Recently I was told by Mr. Michael Noon of Monterey, who had spent years of his early life at various of the California shore whaling stations, that once he had seen a considerable band of fur seals that had landed in a little bight at Monterey near the old custom house.

Just as I have finished this paper I receive from Mr. A. W. Anthony, Director of the Museum of the San Diego Society of Natural History, a letter dated April 15, 1922, telling me of the latest capture of a Guadalupe fur seal on our shores. It is a two-year-old female, captured alive, and has been placed in the San Diego Zoological Garden where it is doing well.

On the whole, the weight of evidence seems to point to the conclusion that of the seals that have been taken on our coast, when taken on land were the Guadalupe fur seal (*Arctocephalus townsendi*).

1. The present absence of the fur seals on the islands is accounted for if they were of the Guadalupe species, which is not the case if they were of the Alaska species.

2. The time of the year that some of the seals were taken on or about the Farallones proves that they, at least, could not have been Alaska fur seals.

3. The evidence of the rapid falling off of the catch in each of the records we have of sealing during consecutive years makes it probable that it was not the great Alaska fur seal herd that was drawn from.

It is hoped that steps may be taken looking towards the absolute protection of this seal, if any still exist on Guadalupe Island, which is probable, together with the small remaining band of elephant seals of the same locality.

The pictures here published of the skull of *Arctocephalus townsendi* (type) were kindly furnished by the United States Biological Survey through the interest of Dr. C. Hart Merriam. It is hoped that anyone finding such a skull on any of the outlying islands will send it to the California Fish and Game Commission at San Francisco. A skull from the Farallones would be particularly valuable. In this way we could learn whether the skull was of the Alaska or of the Guadalupe fur seal; obviously very desirable information. There is danger of mistaking the California sea lion for the fur seal. To show the differences photographs of the skulls of the sea lions are here published. Note that they have much longer muzzles and that the rows of teeth are not nearly so close together.

OBSERVATIONS ON THE EGG YIELD OF KLAMATH RIVER KING SALMON.

By E. A. McGregor.

In 1921 Professor J. O. Snyder published a short note in California Fish and Game entitled "How Many Eggs Does a Salmon Lay?" His conclusions were based on a series of 30 king salmon from the Klamath River. He found that the number of eggs per female varied from 2146 to 4842—a range of 2696, with an average of 3572. Professor Snyder called attention to the fact that the size and egg-content of the right and left ovary usually differ somewhat, and that in his series the left ovary was more often the larger. He further concluded that no very definite relation was to be seen between size, weight, or age and the number of eggs.

The present writer, at the suggestion of Professor Snyder, has recently conducted a similar examination of the ovaries of 68 king salmon from the Klamath River. The method of computing the number of ova was the same as that used by Snyder. It consisted of carefully weighing the ovaries, counting the number of ova per 10 grams, and then calculating the total number. The method was found to be accurate within about one per cent.

It is of interest to note that the author's series presents a somewhat different composition from that of Snyder's. Our ova counts (see Table I) varied from 2013 to 8406, or a range of 6393 and averaged

TABLE I.—Analysis of 68 King Salmon Females With Reference to Length, Age and Ovary Characteristics.

Fish number	Date, 1921	Weight, left ovary, grams	Weight, right ovary, grams	Eggs in left ovary	Eggs in right ovary	Total eggs	Length of fish, cm.	Age of fish
1	8–15	110.4	120.4	966	1,047	2,013	92	5
2	8–27	50.5	49.7	1,164	1,307	2,471	65	3
3	8–12	35.3	29.4	1,331	1,170	2,501	61	3
4	9–2	77.8	75 5	1,291	1,310	2,601	66	4
5	8–15	40.2	41.1	1,333	1,299	2,632	68	4
6	8–16	181.5	181.5	1,316	1,379	2,695	85	6
7	8–31	66.8	62.9	1,386	1,352	2,738	73	4
8	8–24	110.6	115.1	1,355	1,468	2,823	70	4
9	8–16	57.2	54.4	1,499	1,474	2,973	68	3
10*	----------	96.2	98.0	1,477	1,558	3,035	----------	----------
11	8–22	89.1	86.0	1,550	1,496	3,046	71	4
12	9–6	144.5	144.2	1,546	1,500	3,046	81	5
13	8–24	120.2	107.5	1,581	1,489	3,070	76	4
14	8–20	90.5	99.4	1,425	1,650	3,075	77	4
15	8–24	191.6	203.4	1,494	1,607	3,101	80	4
16	9–1	60.6	58.0	1,576	1,563	3,139	70	4
17	8–31	179.1	171.8	1,594	1,581	3,175	84	5
18	8–19	104.0	94.9	1,591	1,590	3,181	69	4
19	8–12	237.0	220.0	1,647	1,609	3,256	86	5
20	9–2	146.0	147.2	1,599	1,678	3,277	100	8
21	8–27	114.1	123.2	1,573	1,725	3,298	74	4
22	8–19	205.9	211.0	1,647	1,656	3,303	86	4
23	8–18	36.3	32.7	1,670	1,635	3,305	66	4
24	8–4	89.0	86.2	1,718	1,629	3,347	77	5
25	8–26	70.1	70.5	1,675	1,685	3,360	71	4
26	8–16	83.5	85.5	1,620	1,753	3,373	73	4
27	9–5	134.8	124.0	1,739	1,674	3,413	71	4
28	9–3	158.6	162.7	1,697	1,749	3,446	88	5
29	8–31	175.6	223.6	1,730	1,756	3,486	91	5
30	8–25	200.9	197.2	1,768	1,755	3,523	82	4
31	8–18	214.0	192.0	1,819	1,718	3,537	75	4
32	8–31	173.4	177.5	1,734	1,819	3,553	78	4
33	8–24	301.4	300.0	1,808	1,785	3,593	86	4
34	8–15	146.4	147.3	1,779	1,834	3,613	81	5
35	8–25	221.9	217.2	1,864	1,759	3,623	88	5
36	8–20	55.0	53.7	1,837	1,788	3,625	70	4
37	8–12	51.0	53.4	1,749	1,896	3 645	69	4
38	9–26	158.2	193.9	1,661	2,046	3,707	84	4
39	9–2	211.0	164.0	2,078	1,665	3,743	87	5
40	9–1	140.4	121.3	1,966	1,935	3,901	81	4
41	8–18	191.4	199.8	1,847	2,058	3,905	86	6
42	8–27	202.5	192.0	1,954	1,978	3,932	81	4
43	8–24	267.2	245.1	2,031	1,912	3,953	90	5
44	8–19	298.2	302.4	1,938	2,056	3,994	93	5
45*	----------	58.0	51.0	2,625	1,436	4,061	----------	----------
46	9–5	148.6	138.0	2,170	1,980	4,150	80	5
47	8–26	156.4	158.9	2,018	2,137	4,155	89	5
48	8–16	215.7	219.5	2,017	2,151	4,168	86	4
49	8–19	185.3	184.7	2,066	2,124	4,190	79	4
50	8–18	300.9	293.0	2,151	2,154	4,305	91	5
51	8–1	254.3	242.3	2,250	2,072	4,322	69	4
52	8–16	179.9	179.9	2,204	2,195	4,399	94	5
53	8–9	309.7	323.0	2,152	2,277	4,429	91	5
54*	----------	273.4	261.2	2,297	2,155	4,452	----------	----------
55	8–15	283.2	301.3	2,266	2,320	4,586	89	5
56	9–1	186.6	195.8	2,174	2,438	4,612	95	6
57	8–27	248.0	252.0	2,306	2,344	4,650	90	5
58	8–26	217.2	212.9	2,367	2,299	4,666	92	5
59	8–22	386.8	355.5	2,417	2,275	4,692	92	5
60	8–20	241.9	294.6	2,121	2,592	4,713	92	5
61	8–25	218.0	265.6	2,125	2,603	4,728	93	5
62	9–3	471.8	454.6	2,477	2,682	5,159	100	6
63	8–9	257.0	277.2	2,621	3,035	5,656	91	5
64	9–6	270.6	306.4	2,625	3,033	5,658	105	5
65	9–3	379.0	370.3	2,994	2,981	5,975	107	6
66	9–2	115.5	102.2	3,407	3,061	6,468	79	4
67	9–5	311.2	338.6	3,781	4,165	7,946	95	5
68	9–1	332.5	515.5	3,225	5,181	8,406	105	5
Averages	----------	177.89	181.49	1,919	1,972	3,891	----------	----------

*Tag number lost.

3891 ova per fish. From the table it will be seen that 37 fish had more ova in the right ovary while 31 fish had more ova in the left ovary, which condition is just the reverse of that in the case of Snyder's series. This strongly suggests that the ovary of one side is just as likely to exceed in size and number of ova as that of the other side.

Figure 69 represents a frequency chart which combines the egg counts of Snyder's series with those of ours (a total of 98 cases). The class interval is 200 eggs. The broken line forms the "curve" resulting from the plotting of the actual cases; the solid line has been derived from the former by the process of "smoothing by threes."

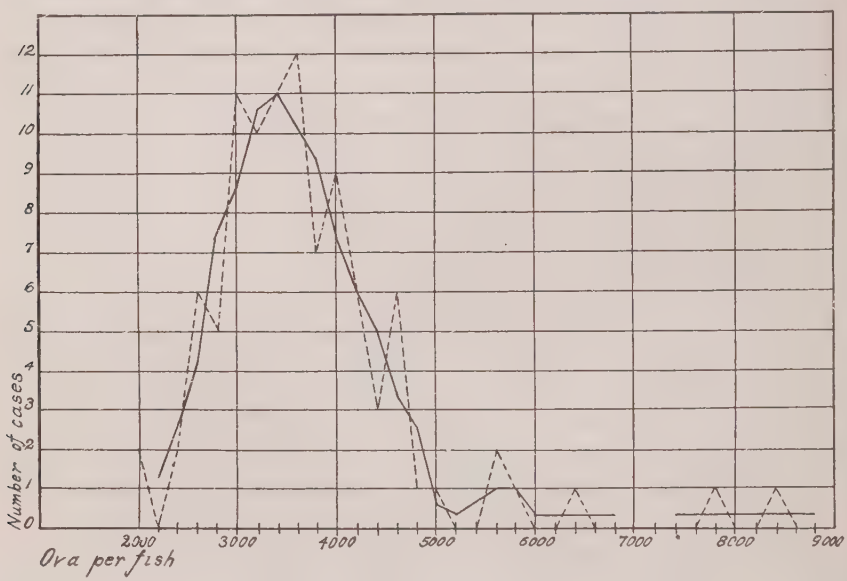

FIG. 69. Graph showing case distribution of the total egg counts of 98 king salmon from the Klamath River.

In the parlance of the statistician, figure 1 constitutes a very satisfactory frequency curve; that is, the great mass of the cases are dispersed rather symmetrically in regard to the mode. The mode is seen to occur at class interval 3400 to 3600 and does not coincide with the weighted average owing to a considerable skewness of the curve on the upper side, caused by a very few exceptional cases.

In figure 70 we present a graph again combining all of Snyder's cases with those of ours. A correlation is shown to exist between "length of fish" and "number of eggs." Each dot on the graph represents a case—98 in all. The continuous portion of the "curve" was derived from the case distribution by the process of twice "smoothing by threes." Beyond either extremity the "curve" is continued by a dotted line which connects with the most remote cases of the series.

It will be seen at once that a rather obvious "trend" exists. We believe that, were we in a position to plot the data from a very large series, the resulting "curve" would approximate a straight line connecting the lower left hand extremes with the upper right hand extremes.

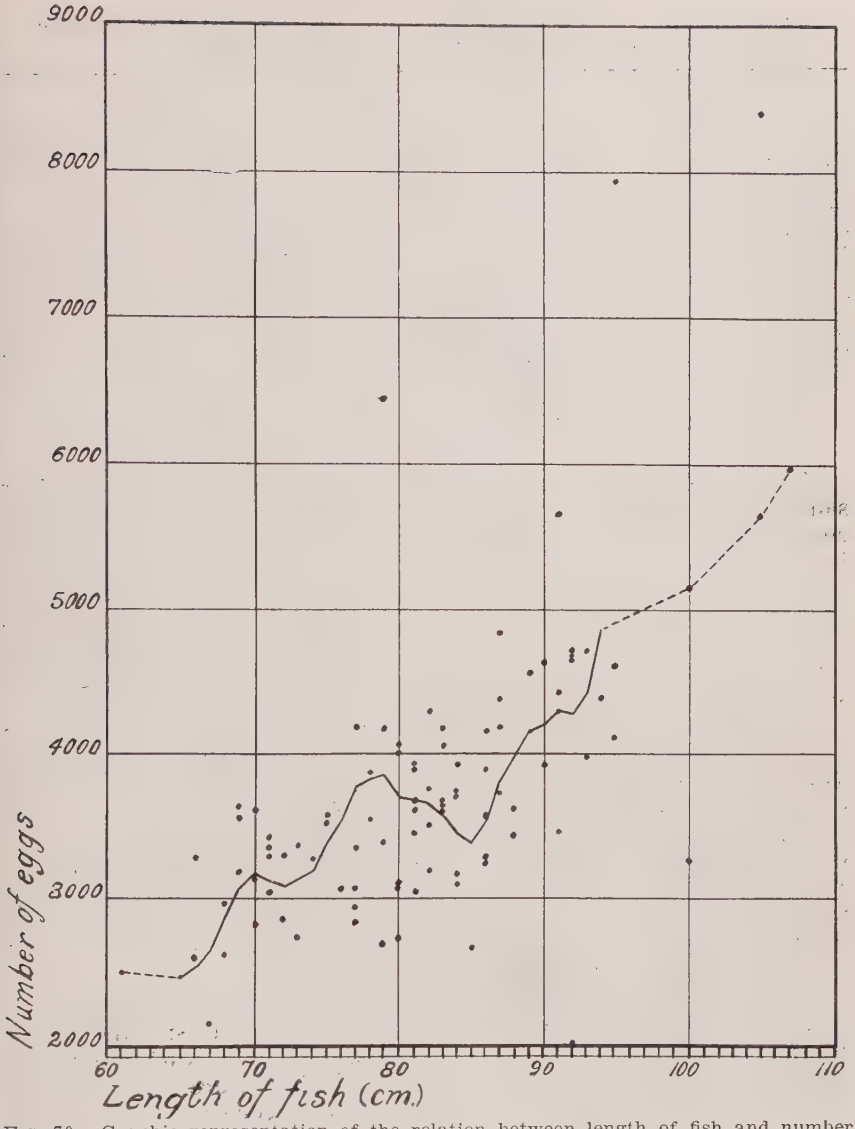

FIG. 70. Graphic representation of the relation between length of fish and number of eggs in the case of 98 king salmon from the Klamath River.

There are four or five cases which do not conform nicely with the mass distribution of the series. For example, one fish 105 cm. long possessed 8406 ova; another 95 cm. long had 7946 ova; while still another 92 cm. long had the fewest ova of any fish of the series—2013. Concerning these aberrant cases, all we can offer by way of explanation is that it is barely possible that these fishes belong to a race or races of salmon alien to the Klamath River or to unusual races native to the Klamath River. If the former hypothesis be true they may be either "stragglers" or fish that have become established through the transplantation to the Klamath system of eggs from other streams.

TABLE II.—Ninety-four Klamath River King Salmon, Tabulated to Show Relation Between Age and Number of Eggs.

Number of eggs (Class interval is 500 eggs)	Number of fish of different ages			
	3 years	4 years	5 years	6 years
2,000 to 2,500	1	1	1	
2,500 to 3,000	2	9		1
3,000 to 3,500		18	6	1
3,500 to 4,000		17	6	1
4,000 to 4,500		7	8	
4,500 to 5,000			7	1
5,000 to 5,500				1
5,500 to 6,000			2	1
6,000 to 6,500		1		
6,500 to 7,000				
7,000 to 7,500				
7,500 to 8,000			1	
8,000 to 8,500			1	
Totals	3	53	32	6
Mean	2,583	3,495	4,344	4,250

Table II is designed to present the data from 94 Klamath River salmon in such a way as to exhibit any possible relation between the age of the fish at maturity and the number of eggs. Such a correlation is actually seen to exist. The mean egg count for the three-year fish is 2583 ova; for the four-year fish, 3495 ova; for the five-year fish, 4344 ova; for the six-year fish, 4250 ova. Only six fish fall in the six-year group, and it is likely that a similar analysis of a much larger series of salmon would reveal that the average number of ova for the six-year salmon exceeds that of the five-year fishes.

Some years ago Mr. N. B. Scofield expressed himself as of the opinion that there is a considerable difference in the number of ova per fish as between the Sacramento River and Klamath River salmon. In 1902 Cloudsley Rutter of the United States Fish Comimssion[1] made the statement that "the average (Sacramento River king) salmon produces about 6000 ova." Mr. W. H. Rich, of the United States Bureau of Fisheries, informs us that the records of the Battle Creek Hatchery, together with his independent observations, indicate that the Sacramento salmon yield an average of about 6000 ova per female. Mr. Scofield's opinion seems to have been substantiated.

Such a study as that embraced in the present paper has both a zoological and an economic bearing. From the former standpoint it is patent that a careful diagnosis of a considerable series of individuals, with reference to such a fundamental biologic feature as the number of ova, is certain to be usable at some future time in matters where specific and racial relations are concerned. The most obvious economic application of our data lies in the contribution toward a knowledge of the relative prolificacy of the various races of salmon. Such a knowledge will have a very direct bearing on the operations of egg taking and spawning. By exercising a selective choice as between salmon races, it is not unreasonable to suppose that much good may thereby result in propagation practices.

It is to be hoped that the present study may be followed by others of a similar nature with reference to the Sacramento and possibly other salmon runs.

[1]Popular Science Monthly, July, 1902.

THE FISHERIES OF CALIFORNIA AND THEIR CARE.

By Will F. Thompson.*

The scientific investigations necessary for the care of the fisheries of California can not be understood nor formulated without some knowledge of the condition of these fisheries and their relation to those of other regions where investigations have been carried on. The brief presentation of the difficult material will, it is hoped, arouse interest in the really important problems to be faced.

The fisheries of California are recent in origin—that is understood by everyone as a natural result of the recent settlement of the State. But just how recent they are as really great fisheries, and how in that respect they correspond to the other great fisheries of supposedly much greater age, is very little known. They are in reality the result of normal influences acting throughout the world, although to the dealer or the fisherman their origin may seem connected with such phenomena as war or the depletion of other fisheries such as salmon. Whatever the specific causes of their beginning, there can not be much doubt but that a place existed for them, or they could not have arisen to their present height.

The progress of exploitation of our fisheries has been slow and steady until recently. In 1880, at the time Dr. Jordan made his survey of our coast fisheries, they existed, as he said, mostly as possibilities. Other surveys were made in subsequent years, as 1889 to 1892, 1904 and 1908, and some growth was noted. Then in 1915 the Bureau of Fisheries figures indicated a great rate of increase. And since 1915 the annual summaries of the California Fish and Game Commission have shown, on the whole, a surprising enlargement, especially of the total used for canning. (Fig. 71.)

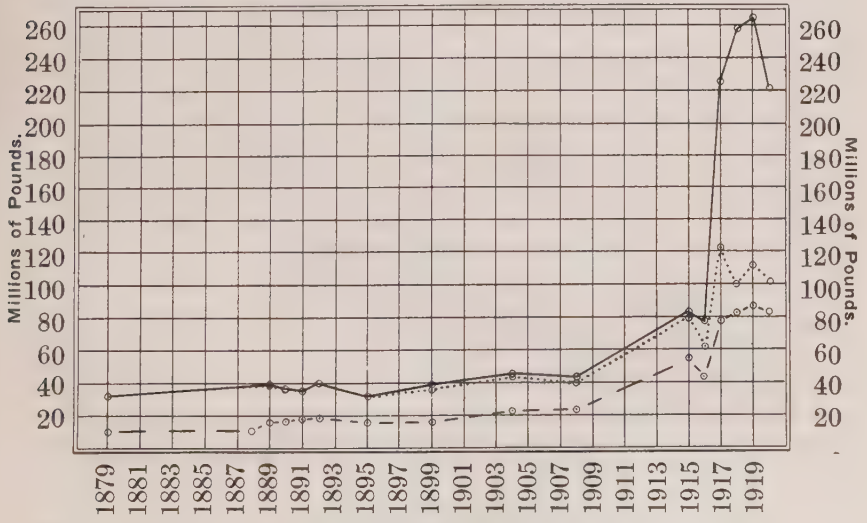

Figure 71. Growth of California Fisheries.

——— All marine fishery products except Alaska cod and oysters.
. . . . . Same, less sardine.
- - - - - Fish only, less salmon, cod and shad as well as sardine.

*A report made to the Committee on Conservation of Marine Life of the American Association for the Advancement of Science. The assistance of Frances N. Clark in the collection and preparation of data used in this report is gratefully acknowledged.

Not merely does the grand total show a rise, but those for the individual species have climbed steadily. Attention should be called, for instance, to the barracuda, the consumption of which can not even remotely be called of war origin or temporary in nature. Vastly greater amounts have been used in the more recent years, as is shown by the accompanying chart. (Fig. 72.)

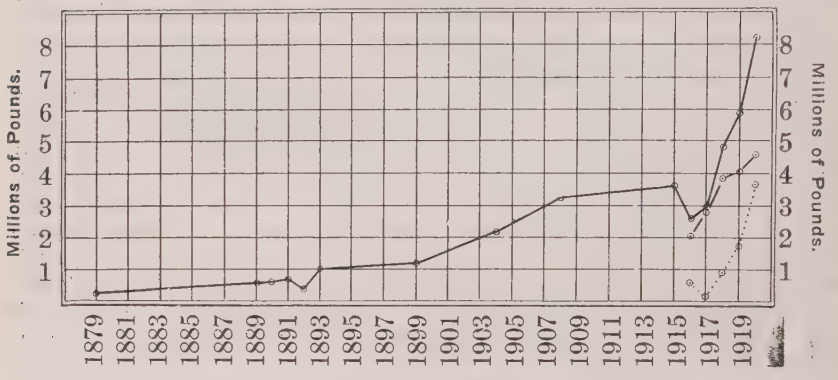

Figure 72. Barracuda Landed in California.

——— Total landings.
- - - - - From California waters.
. . . . . From Mexican waters.

But aside from this general increase, other things have been happening in California waters. One of these is the steadily falling importance which the mollusk and crustacean fisheries show, contrasting with the rise in the catch of the marine fishes. The exploitation of the mollusks, such as the abalone for jewelry, and the shrimp for fertilizer in China, were what one might call freak fisheries, for easily obtained products, to satisfy a demand that already existed—one to small extent only dependent upon the population of our country or its transportation facilities. These fisheries shortly reached their

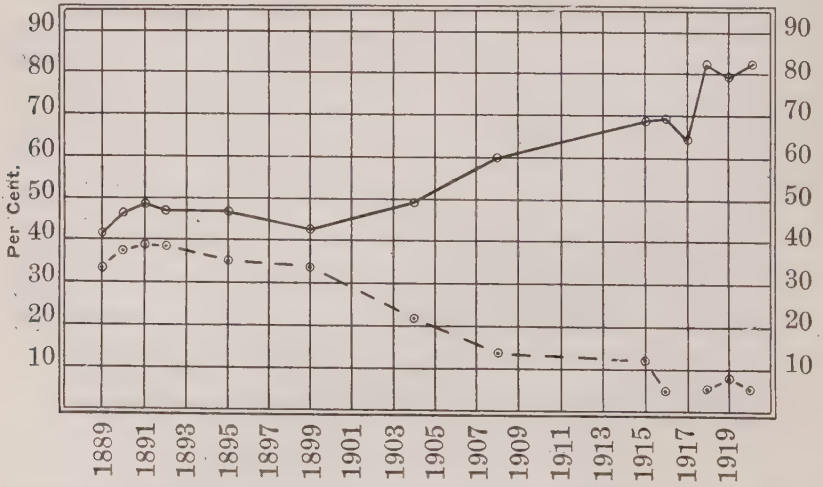

Figure 73. The Percentage Certain Categories Form of all Marine Fishery Products, Except Alaska Cod and Oysters, Landed in California.

- - - - - Fish, less salmon and shad.
-.-.-.- Crustaceans and mollusks.

climax, and have recently sunk both absolutely and relatively to minor importance as compared to the fishes used for food. The phenomenon is one indicating the maturity, in a certain sense, of our fisheries, when the great and growing demand for foods asserts its rightful place over the incidental demands which have run on before. (Fig. 73.)

Another phenomenon to which it will be well to call attention is the fact of the actual failure of our own waters to produce a sufficiency. The spiny lobster is an instance of this, as the accompanying graph will show. Since in the early statistics it is impossible to separate lobsters of Mexican origin from the relatively very few landed in San Diego from California waters, one category has been formed of Mexican plus San Diego lobsters and contrasted with those from other counties of the State. The invasion of Mexican waters is well illustrated. Another instance of the same is the barracuda, likewise shown in a graph. The demand for these fish is being satisfied to an increasing extent from Mexican waters, although here the adequacy of the available statistics may well be questioned. The fact, however, is clear, that a process which has occurred in other older fisheries has begun here, namely the outgrowth of the domestic supply by the demand, so that fishing grounds farther away are being used. It will be interesting to see how far the process, which in Europe carries fishermen to the Barents Sea and to tropical Africa, can and will go. It very probably will be found to accompany over-fishing of our own grounds, as it has in European waters.

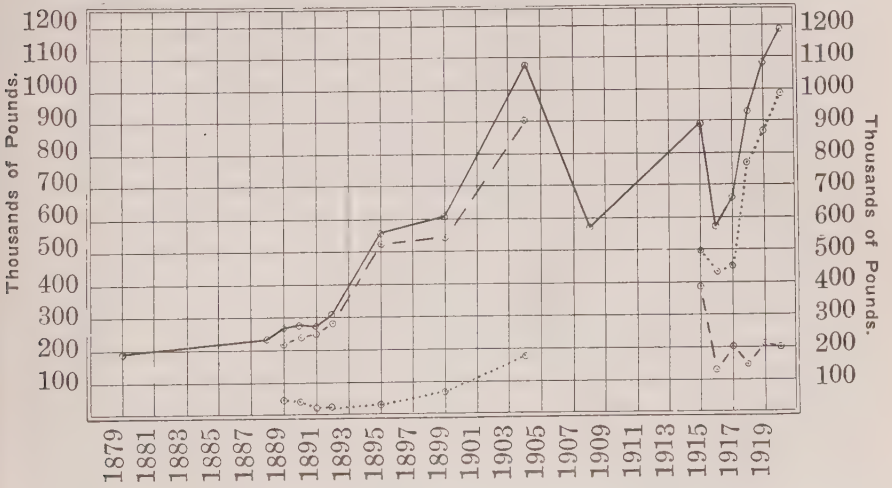

Figure 74. Spiny Lobsters Landed in California.

——— Landed at all ports.
. . . . . Landed San Diego and Mexico.
- - - - - Landed other California ports.

It seems, from what has been presented that our fisheries are of not merely recent, but very recent origin. In certain individual cases, there seems not to have been time yet for over-fishing to have shown its effects. The young born while the fishery for barracuda was still small have barely come to full maturity. Their abundance, therefore, can not have become very seriously affected yet. But the question is not what

has happened but what will happen. That the future is more than doubtful can be demonstrated.

If trouble were afar, and it were possible safely to say, "Let us overcome that problem when we get to it," this report would not carry much weight for the ordinary man. But there is every reason to believe that the problem is near at hand. Our fisheries have advanced farther than we have perhaps dreamed. Indeed, in the flush of their youth and the existence of a rich accumulated reserve, they have perhaps gone too far. The biologist should be in a position to eliminate that *perhaps*, and to put either *not*, or *certainly* in its place. It is a tribute to the slight interest that is taken in practical biology that not even an attempt has been made.

How far have our marine fisheries really gone? For answer we might make a comparison with such fisheries as those of Europe. They are popularly believed to be the most ancient and most extensively exploited of any, but a comparison is difficult, as we shall see. Should we compare our fisheries in California with those of a restricted area like that of the North Sea, or with those of all the seas to which European vessels go? Should the basis be the area of the coastal banks within the 200-metre line which is commonly accepted as limiting most great fisheries? Or should it be the length of coast line because the vast body of the ocean determines the abundance of the fish? Pelagic species might be compared on a basis of coast line, demersal on a basis of fishing banks, but demersal species are dependent upon pelagic animals, and pelagic animals in good part upon the coastal waters. Certainly the truth seems to be somewhere between the results obtained by comparison of length of coast line and area of fishing banks.

To obtain some basis for comparison, let us for the time being adopt the conclusion generally held sound, that all great fisheries are very largely limited by the extent of the coastal waters and the area of the banks within the two hundred metre line. The albacore ranges well beyond that, as indeed the sardine does, but that does not necessarily invalidate the applicability of the rule, which certainly seems to hold for demersal or semidemersal fishes.

The North Sea is for the greatest part within the two hundred metre line and has an area of 152,500 square miles (geographic) according to the International Council for the Investigation of the Sea (whose data will be used unless otherwise stated). The crest of this production was reached for the time being, in 1913, just before the great war, and it will be legitimate to compare that with our maximum year in California, 1919. The catch in our waters was about 125,000 tons, in those of the North Sea 1,408,000, a ratio of one to eleven. But the area within two hundred metres is, off the whole coast of California, but about 7500 square miles, in the proportion of one to twenty to that of the North Sea. In other words our waters seem to be producing nearly twice the amount per square mile.

If the seas of the Atlantic coast of Europe, with the Baltic, Barents Sea, the White Sea, and the Moroccan Coast included, minus the area within the three-mile international limit, are considered, a total of about 700,000 square miles is found (Board of Agriculture and Fisheries for England, 1906). The total yield in 1913 was 3,077,000 tons. The ratio between the California area and the above area is one to

ninety-three, of the catches one to twenty-five. Hence three and seven-tenths as much per square mile is taken from our waters.

The question then arises as to whether the fisheries are really comparable, and as to the relative part the pelagic fishes play in the total. One may compare the herring, the sprat and its allies in Europe with our sardine and herring, and find that 64.4 per cent of the catches in our waters are composed of these species, as contrasted with 67.1 per cent in the North Sea, and 45.2 per cent in all Northwestern Europe. It would seem clear from the comparisons that our use of the herring-like pelagic fishes is extensive, but not much more so than that made in European seas.

In so far as the remaining species are concerned, the cods take the place of our mackerel-like fishes if to our mackerels are added the larger round predaceous fishes such as the barracuda and the salmon. The following table illustrates this:

	North Sea	European Seas	California
	Per cent	Per cent	Per cent
Flatfishes	5.9	4.7	3.7
Herring-like fishes	67.1	45.2	64.4
Cods	21.5	39.8	
Large round fish			10.7
Rockcods			2.1
Mackerel-like fishes	1.9	2.4	17.4
Sharks	.9	1.2	.4
Small fish	1.0	1.8	.9
Miscellaneous, unclassified	1.8	5.0	.4
Totals	100.1	100.1	100.0

The compositions of the catches in the two areas do not vary widely in their essentials, and the relative intensity of fishing holds as much in the comparison of the minor groups as it does for the entire. Thus in the case of the flatfishes, the most typically demersal, the percentages do not vary widely enough between the areas to change the conclusion as to relative intensity deduced from the comparison of the entire fisheries.

The comparison might justifiably be ended here, if it were not possible that the use of such areas as a basis is an error. And, indeed, if the length of coast line of Atlantic Europe is used as a basis for comparison, the proportion of coast line (including the Baltic with its large herring fisheries) is roughly one to fourteen, as contrasted with that of the catch of one to twenty-five. Yet such a comparison errs at least as far in the other direction as does the use of areas, for it is very widely accepted that the North Sea is a very important part of the whole and that it owes its importance to its most remarkable area of shallow water banks, seemingly highly suitable for the production of the cods and flatfishes.

A more valid objection to the comparison of areas is the fact that in California the so-called pelagic fishes bear more of the burden than in Europe. To meet this a comparison may be instituted between the catches of pelagic fishes such as the mackerel and tuna, the sardines and herrings. There may then justifiably be added the albacore and tuna fishes—as representing the mackerels—to the sardine, and very probably the salmon fisheries are also properly pelagic. The "pelagic" fisheries then become as two is to twenty-seven, as contrasted with coast

lines of two to twenty-eight (very approximate). In other words the pelagic catch is nearly the same per mile of coast line.

Such exactness in comparison is very obviously not justifiable, as any biologist will see numerous objections and limitations to it. Prominent among these is the probable difference in productivity of the oceanic waters. But the point must be apparent that our fisheries, to be comparable at all, must have reached a high degree of development. And they probably are at present yielding more than the North Sea fisheries in proportion. What is the significance of such a fact, and where its danger?

The danger is for the most part in ignorance and lack of foresight. Our fisheries are steadily increasing. They will continue to increase just as fast as our population does, and every perfection of transportation, of preservation, or of marketing will add to that population increasingly large numbers from the inland peoples. The building of great cities with their dependence upon imported produce, and the industrializing of whole nations will enlarge the proportion of people dependent upon such sources of food as the sea. So the whole of modern civilization indicates increasing use of the resources of the ocean, and unless one lacks faith in the progress of the world, those resources must be conserved. The yield from the fishes can not be doubled every ten years and the limit not exceeded.

The sharp and recent rise in intensity of our fisheries is but a variation in the general rise taking place everywhere throughout the world. In the North Sea, where depletion is accepted as occurring and as proved at least in certain lines, the exploitation of the sea really began in 1880 or shortly thereafter, when steam first came to be used in vessels. Then in 1895 the otter trawl opened to the fishermen depths below fifty fathoms, and since then successive improvements have increased many times the efficiency of the gear used. The really great North Sea fisheries are in fact very recent, and those of the other seas of Europe still more recent. That depletion should come in this dawning of the era of exploitation is ominous to us, for there is no reason to suppose our fisheries immune from similar consequences.

There should not be any doubt in the minds of reasonable men that the North Sea has been exploited to its limit, and beyond in many respects. That is especially true of the plaice and the haddock. But there are two things concerning the North Sea and indeed all fisheries that need emphasis. One of these is the lack of data which indicate the condition of the fisheries previous to the last ten years. The other is the vast amount of labor now required to obtain a yield as compared to what is necessary in a virgin fishing area such as ours still is. This may be illustrated readily.

A pair of small steam tugs dragging a paranzella net with 50-foot spread catches off San Francisco an average of 6500 pounds per day, making two hauls of two hours each. But a modern steam trawler takes only 1700 pounds per day in the North Sea (Jenkins, The Sea Fisheries p. 158), not much over a fourth of the California catch, despite the far more efficient apparatus, and the practically continuous day and night fishing. It would seemingly be conservative to estimate the abundance of fish in the North Sea as not a tenth what it is on California grounds, in view of the differing efficiency of the gear.

It therefore seems justifiable to scientists far removed from the heat of the discussion to conclude that the North European Seas are really well along on the road to exhaustion while those of California are in comparison relatively unharmed, and a careful perusal of the existing data does nothing to shake such a conclusion. True enough, the evidence of depletion is in part unable to bear critical scrutiny, being highly complicated and defectively gathered. But the discovery that the existing evidence is faulty as regards many of the species investigated, provides no proof that over-fishing has not occurred, nor a lessening of the significant indications. On the contrary, it seems that depletion must be proceeding rapidly to provide even the proof that is obtainable in the welter of complications.

From such consideration as has been given of what has happened elsewhere during this world wide increase in intensity of fishing, it is possible to see where the danger lies for our California fisheries. Will they continue to grow without observation, and will there come a time when we will not know even remotely whether our fisheries are approaching exhaustion? That is exactly the state of affairs in Europe and may well be here.

Exhaustion does not necessarily become obvious to everyone when it occurs. The cost of catching fish is but a fraction of the cost of distribution. Thus the fisherman may receive eight cents per pound, where the retailer asks forty cents, and doubling the fisherman's price would add but a fifth to the retailer's price. The consumer is, moreover, willing to pay high prices for a product to which he has become accustomed, and the rarer it is the more he will pay. But there are, in addition, influences which actually counteract the effect of increasing scarcity in raising the initial cost. The accompaniments of that intensified exploitation which results in depletion are the constant broadening of the fishing grounds, the inclusion of more than one species of fish and of inferior quality in the catch of the boats, the development of means of preservation, the constant improvement of gear and the increase in quantity of apparatus. All these things tend to eliminate the great and sudden fluctuations in amount of yield which are characteristic of fisheries confined to one species or one locality. These variations in yield render the exploitation of the fisheries expensive and uncertain because the periods of abundance must be made to pay interest upon the capital and to maintain the organization during periods of scarcity. Their elimination as a result of intense fishing undoubtedly does reduce the cost of fish to the consumer, perhaps to the extent that for a while the influence of depletion in raising the initial cost will not be felt.

But in the end that very fact may defeat the natural safeguard which should protect a species, namely the lack of profit in carrying on a fishery when it comes dangerously near to exhaustion. It becomes possible to prolong a fishery because other species are taken; the by-product becomes the mainstay of the business and the depleted species is kept under a strain for which it could not itself pay. If it were not for cod, perhaps the halibut fishery of Iceland might have long since collapsed; and if it were not for the cheaper round fishes, the flat fishes in the North Sea might be pursued far less rigorously. On the Pacific Coast, the tuna and sardine fishery of California may have been of considerable assistance to the albacore fishery. In fact, the objection often raised to the possibility of over-fishing, that the fisheries

are prospering and that they would immediately cease to prosper should depletion in any one species occur, is not a valid one. But that they would ultimately fail as a result of over-fishing seems sure.

We have seen that our fisheries have recently undergone a very marked development paralleling that occurring elsewhere in the world, that their intensity equals or exceeds that in older over-fished areas, and that there is every reason to anticipate over-fishing here. In addition we have seen that it is necessary to keep data which will prove the condition of the fisheries. What the nature of that data is can be stated confidently from the experience of those men who have investigated the North Sea.

NATURE OF DATA NECESSARY.

Although the nature of the data necessary can be stated confidently, it is not easy briefly to define their extent and their complexity.

The primary requirement is knowledge as to the relative abundance from time to time of the fishes concerned. The actual abundance is out of reach of ascertainment, but an index to the changes therein is possible. And the first as well as the most ignored of the connected problems is the efficiency of the measures utilized. The taking of experimental catches by special apparatus has proved both expensive and futile and the general consensus of opinion is that the commercial catches furnish the best evidence.

But the commercial catches are the result of many factors, among which are the changing of gear with the years, the use of vessels of increasing efficiency, and the use of grounds farther afield. Such factors may be avoided by competent statistical methods.

In addition there are well pronounced meteorological and oceanographical influences affecting the catch and the fishes themselves, to an extent undreamed of by a person unacquainted with the fisheries. No avoidance of the effects of such is possible, save by the gathering of data over periods of time of sufficient length to allow the influences to counterbalance each other and reach a stable average. It is well known that successive years are more truly comparable through their averages than through identical months or days, because although the returns for the latter fluctuate widely, they tend to vary above and below, and around a mean. The study of how extensive the statistical records must be to present a true picture is one of the major problems which must be attacked.

After the solution, or the approximate solution of such problems, there remains the question of the significance of the actual changes in abundance discovered. In various fisheries there have been found great natural changes seemingly entirely unconnected with man's influences. So that one of the greatest problems to be faced is the distinction of such widespread variations and the effects of over-fishing. As Hjort has indicated in the case of the herring, and as we may find in our sardine, the spawning of a given year, say 1910, may provide the fish in the commercial catch for ten or twelve years, and the fishery may rise and fall in accordance with the growth and disappearance of that class. A careful theoretical consideration of the possible criteria for the separation of such phenomena from the effects of over-fishing, has still to be made, and in addition, these criteria must be tested.

But there is one fact acknowledged and capable of use in such separation, namely that over-fishing diminishes the abundance of the older

fish, whereas during natural fluctuations a certain cycle of changes occurs. For the use of such a criterion a direct age assessment is necessary, or failing that a size assessment. That implies, both for the purposes of age or size assessment, and for the correlation of the discovered changes with physical and economic phenomena, an accurate knowledge of age and rate of growth. That is a purely biological problem of considerable difficulty, but it also involves a knowledge of annual migrations sufficient to assure the investigator that he is not drawing his material from varying sections of a population undergoing differential migration according to age.

The above are the essentials in the immediate care of the fisheries. There are omitted the investigations of such problems as the spawning periods, the existence of races according to locality, and similar facts which may be assigned as causes for various effects observed. The biologist can not omit them from his investigations, simply because of their utility in the formulation of theories and the explanation of facts, not so much because of their direct importance; but they should be assigned a purely secondary place in the work of preservation of our fisheries.

Finally, there are the problems connected with remedial legislation. These are mainly concerned with two things, one economic, the other biological. One is the existence of waste which may possibly be eliminated, to the benefit of the species, the other is the relative worth of protection to the various stages of the life of the fishes. Protection may be assigned at any stage for the actual purpose of reducing the catch, but the psychology of the public demands that some such ostensible reason as the capture of spawning or of immature fish be used. In so far as possible a really rational basis should be substituted for such totally unscientific ones, and this rational basis will seemingly demand a knowledge of rate of growth and of the death rate at various periods.

It will be seen from the above that the work to be done is of a more or less practical nature, interpreted from a background of biological and oceanographical knowledge. The more perfect this background the more perfect the practical results. So that it becomes a matter of first importance that the general biology of the fishes and the varying conditions in their environment be thoroughly investigated.

INVESTIGATIONS NECESSARY.

An indispensible basis for the study of our fisheries, both from the point of view of over-fishing and of the greater fluctuations which occur, is a system of statistics. It should be far more perfect than the ordinary compilations that masquerade as statistics, and should be collected by the biologist.

The first requisite of such a system is the provision of some measure of the relative abundance of the fishes concerned. The unit by which such abundance is measured must be a constant one, as far as possible, and it has been found that such units are difficult to find and variable according to the fishery. In the case of otter-trawls, the catch per hundred hours of fishing with a certain type of trawl; in the case of trawl lines, the catch per unit length of gear run; in the case of boats trolling for pelagic fishes, the catch per day of a given type of boat.

In other words a perfect statistical measure of abundance would depend upon the particular fishery investigated.

That, however, is plainly out of reach. Some less perfect measure, the error in which can be counteracted by the collection of sufficient data, must be substituted. In the case of our California fisheries, the same gears and vessels will in the long run tend to be fished to their full capacity to make them pay, or the variation in the way they are used will be relatively little from year to year. A careful record of boats, their gear and their catches is therefore reasonably good for the purpose of gauging the relative abundance of fish from year to year.

1. It is therefore proposed that the statistics to be gathered cover such details, and that the catches of the *individual* boats be compared from year to year to show the variation in yield. The comparison of individual boats is emphasized because it is obviously wrong to compare the catches of different boats. The changes in numbers of vessels, type of gear used, total catch, etc., and the market demand, should be incidental to this.

The method of collection of these statistics should be rendered as free from the personality of the collectors as possible. The completeness of the data obtained should rest neither upon the shrewdness nor the affability of the man in charge. It would be far better to have a uniform error year after year than a change from complete to incomplete as the personnel concerned change. In other words the collection of statistics should be systematized to act automatically and should be enforced by law. An illustration of the possibilities and feasibility of such a method is to be found in the present system of the California Fish and Game Commission.

It need hardly be necessary to point out the desirability of joint international action in the collection of such statistics. The United States-Mexican boundary line is conveniently placed for assisting in determining the points of origin of the catches.

Such a system of statistics may be made automatic, and its results filed away for reference.

2. The collection of special statistics should supplement this system and be applied to any fisheries threatened. An instance is to be found in the albacore fishery. In that there should be (*a*) a continuous record of the shifting locality of the fisheries, and (*b*) a series of measurements or age determinations throughout the season to determine the relative frequency of the age classes. One man could follow both the sardine and albacore fisheries, and perhaps the barracuda fishery from a given point, as San Pedro.

Such data should show the range of the fishery, and its expansion. Also the exhaustion of successive localities.

The age or size assessment should show the diminution in average size which is supposed to be an earmark of over-fishing. It has been much used, for instance, in the case of the Plaice fishery of Europe and has been found to hold for other fisheries, such as the halibut. From it also could be determined the presence or absence of fluctuations due to the relative success of the spawning seasons, a matter of great importance, as Hjort has shown in the case of the herring.

3. The biology of the fishes concerned should be studied to direct and supplement the above work. The most needed facts are those as to

rate of growth, the migrations, and the causes of variations in abundance.

4. The first three divisions are those which are directly necessary for the care of our fisheries. But the adequate explanation of their fluctuations and an understanding of the more fundamental biological aspects of the fisheries undoubtedly depends upon a knowledge of the ocean, its currents, its contained life and the changes therein. The investigation of such facts should be carried on by those agencies not directly responsible for the observation of the condition of the fisheries, although certainly the latter should also aid where possible.

The specific investigations immediately necessary for the preservation of the California fisheries have been already undertaken by the State. It should be granted, under present conditions: (1) Support in the maintenance of its present program, and (2) representation in any organization designed to further the investigation and conservation of the fisheries, such as should be formed to bring into harmony the efforts of the various states, and the national government.

The more general investigations urgently needed for the enlightened and scientific care of the fisheries include the following: (1) The determination of the ova of our fishes, the period and direction of their drift; (2) the measurement of the amount of migration of our pelagic fishes, including a comparison from a racial or specific standpoint of the larger mackerels in California, Hawaii and Mexico; and (3) the recording of the oceanographical changes which may be correlated with the fluctuations in the abundance of fishes shown by the statistical and biological investigations. For these investigations ocean going vessels will be necessary, and their provision, as well as their program, must be determined by experts in conference.

In closing, it may be proper to summarize in a sentence what has been said. A science of vital statistics is proposed, and the basis for it must be governmental action founded upon biological knowledge.

APPENDIX.

DISCUSSION OF TABLE AND GRAPHS.

The statistics shown in the appended table are drawn from the reports of the United States Bureau of Fisheries until the year 1915 inclusive. It is highly regrettable that they are scattered and irregular in point of time although the general trend of the fisheries is illustrated. Moreover, their method of collection is not that which is recommended in this paper, and naturally the writer does not have any great faith in their freedom from error.

The data obtained for the years 1916 to 1920 inclusive are taken from the reports of the California Fish and Game Commission. With regard to these, it must be pointed out that the statistics for 1916 and 1917 were collected in a different manner and are much less dependable than those for the three later years. For example, to what extent the seeming fall in 1916 is due to defects in the method of collection, either of the United States Bureau of Fisheries in 1915 or the California Fish and Game Commission in 1916 and 1917, is now impossible

of ascertainment. It is therefore apparent that really accurate statistics are obtainable for but three years, including 1920. But the earlier data are surely sufficient to illustrate the general tendencies shown in the total catches of the various fisheries.

As the purpose of the table and graphs is to illustrate the tendencies of the native marine fisheries, various categories of returns ordinarily included are omitted. Thus the cod bought from Alaska is everywhere subtracted, as are the oysters because they are cultivated and imported as spat. The anadromous salmon and shad are omitted in some instances because the first have been the object of special long established river fisheries, and are aided by hatcheries, while the second species was transplanted from the Atlantic. Sardines packed in California showed very great changes due to war conditions, and their use may be regarded by some as not a part of the normal growth in our fisheries. In figure 1, provision has been made for those who prefer to ignore this fishery, and the increase in our fisheries is demonstrated without it.

It remains to call attention to the difficulty faced in distinguishing barracuda and spiny lobsters from Mexico. The figures obtained at present are probably much more nearly correct than those obtained previously. In fact no provision seems to have been made in the Bureau of Fisheries figures for Mexican importations. For that reason the spiny lobsters landed in San Diego have been all regarded as Mexican in origin, simply to emphasize the southward movement of the fishery. (Fig. 74.)

The treatment of these statistics summarizes practically all that is known concerning the increase of our California fisheries. It is exceedingly regrettable that the record is so imperfect and that it is confined to the total catch alone. No correlation of the changes with the great increase in the population of California since 1905 has been attempted, although the comparison is inviting and the connection between them seemingly intimate.

MARINE FISHERY PRODUCTS OF CALIFORNIA, 1879-1920.

	1879	1888	1889	1890
Marine fishery products, less cod and oysters	*31,249,020	----------	37,995,521	36,257,047
Sardines	900	5,140	1,097,397	1,314,800
Fish, less salmon, cod and shad	8,578,200	9,735,726	16,267,043	17,659,322
Mollusks and crustaceans, less oysters	6,661,100	11,609,755	12,415,769	13,136,555
Barracuda, including Mexican	200,000	----------	500,714	511,078
Spiny lobsters, including Mexican	190,000	**231,061	266,458	278,310

*Includes Alaska cod. **Doubtful.

	1891	1892	1895	1899
Marine fishery products, less cod and oysters	35,014,133	38,636,594	31,820,131	39,073,122
Sardines	937,568	752,904	732,293	2,383,000
Fish, less salmon, cod and shad	17,512,927	18,567,258	15,258,543	18,040,112
Mollusks and crustaceans, less oysters	13,095,216	14,634,809	10,953,895	12,387,114
Barracuda, including Mexican	694,793	326,804	979,674	1,191,505
Spiny lobsters, including Mexican	272,245	303,275	558,054	606,713

	1904	1908	1915	1916
Marine fishery products, less cod and oysters	44,691,978	43,236,000	82,978,228	77,717,206
Sardines	1,036,470	4,638,000	4,389,105	15,402,578
Fish, less salmon, cod and shad	22.615,811	27,549,300	58.475,366	58 640,295
Mollusks and crustaceans, less oysters	9,370,008	5,267,000	9.829,987	3,228,269
Barracuda, including Mexican	2,159,282	3,205,000	3,592,646	2,589,653
Mexican barracuda				571,792
Spiny lobsters, including Mexican	1,078,065	573,000	892,392	572,536
Spiny lobsters from Mexico and San Diego				341,026

	1917	1918	1919	1920
Marine fishery products, less cod and oysters	225.910,101	257,909,441	264,744.525	220,729 600
Sardines	105,098.112	157,652,811	153,877,179	118,520 914
Fish, less salmon, cod and shad	183,444,843	240,579 110	241,227,824	202.775 842
Mollusks and crustaceans, less oysters	23,883,931	5.472,728	8.797,410	5.386 385
Barracuda, including Mexican	2.956.812	4.837.284	5,824.657	8.201.335
Mexican barracuda	165,115	951,593	1,786,105	3.615,947
Spiny lobsters, including Mexican	659,318	930.827	1,089,465	1.189.196
Spiny lobsters from Mexico and San Diego	255,444	735,077	832,571	942 020

THE CATTLEMAN'S RIGHTS.

By Roy M. Hagen, Secretary California Cattlemen's Association.

The range cattlemen of the state are much disturbed over the annual loss of cattle due to the carelessness of deer hunters which seems to be increasing year by year. Not only are cattle actually killed and seriously wounded by careless hunters in the mountains, but perhaps even more serious than this is the manner in which cattle are driven from the range by the tremendous number of hunters who go into the hills and camp at water holes, depriving the cattle of necessary water and permitting their dogs to chase cattle to the extent that cattle are often driven from the high mountain ranges to lower elevations where poorer feed conditions exist, sometimes as much as six weeks before they normally would work to lower elevations. It has been conservatively estimated that this disturbing of cattle by hunters camping at water holes and by the use of dogs, causes a loss of between $2 and $3 per head annually.

There never was a question which did not have two sides with considerable logic and good reason on both sides. It is not the desire of the cattlemen to secure the passage of any laws which will unduly restrict the activities of hunters or vacationists in the mountains. The cattleman feels that the public has a right to these privileges, but he also stoutly maintains that he is entitled to consideration and that his property must be respected.

It is unfortunate that a comparatively small number of hunters cause most of this feeling on the part of the cattleman. It is undoubtedly true that the majority of hunters use discretion and a reasonable amount of common sense while in the mountains. It is the few who fail to respect property, who kill cows, steers and more particularly calves, who cut fences, who intentionally drive cattle away from water holes, and who leave gates open, who are responsible for the present

feeling and who will be responsible for any necessary restrictions which may possibly be forced on all hunters in the future.

It is probably true that the average cattleman does not fully appreciate what is done in his behalf by the Fish and Game Commission. This Commission is constantly endeavoring to secure the passage of reasonable laws which will be possible of enforcement and which will protect game and the rights of cattlemen at the same time. Probably comparatively few cattlemen know that the $2 paid for a hunting license by each hunter, goes into a fund for the paying of a bounty on mountain lions which are killed. The Fish and Game Commission is the only organization in the state which pays any bounty on the killing of mountain lions. Each year there is an average of 260 mountain lions killed on which a bounty is paid. It is quite possible to estimate that each lion would account for five head of livestock annually, or in other words, a saving of 1300 head of cattle annually to the cattlemen in the state. This saving of 1300 head of cattle by the killing of mountain lions goes a long way towards offsetting the 300 or more head of cattle killed annually by careless hunters, but that is not the whole question as pointed out above. There are approximately 150,000 head of cattle ranging on national forests in the sections of the state most frequented by deer hunters. Let us suppose that one-half of these cattle are disturbed by hunters and that the loss from such disturbing is $2 per head annually. This means a loss to cattlemen of $150,000. The saving to the cattlemen through the killing of mountain lions could possibly be estimated at about $75,000, which leaves a net loss to the cattlemen of $75,000 annually, as a result of the careless gun of the hunter and the unrestricted use of dogs.

It can not logically be expected that the cattleman will sit by and accept this loss without a word of protest. The cattleman pays for the use of his mountain summer range, and feels he is entitled to the use of that land for the entire season. If his cattle are driven from that range, he not only fails to receive what he has paid for in pasturage, but his cattle fail to make the proper gains and he is forced to provide feed for them at lower elevations which is an added expense.

As evidence of the fact that it is the few reckless hunters who spoil the privileges of the conservative hunters, I wish to state that I have in my office a bell taken from a cow coming from the range in the fall of 1921, which bell has a bullet hole through its center. It can be readily imagined that two "wild Indians" possibly in the mountains for the first time, ran out of interesting targets, and one of them said to the other, "Watch me ring the bell." Whereupon he promptly "rang" the bell. Of course, if all hunters were equally good marksmen, the loss of cattle would not be as great, but unfortunately too many such men "rang" the cow and not the bell. It can be easily understood that the cattleman owning that cow from which such a bell was taken, will not be kindly disposed towards hunters on his property, and during the coming deer season some hunter will probably fail to understand the hostility with which he is greeted by the cowman who runs across him on his range.

Since it is the few who destroy the privileges of the many, I have but one suggestion to make, and that is that the hunters themselves should try and personally live up to the "reminders" printed on the

back of each 1922 hunting license, and insist that every other hunter should do the same. It seems to me that this is absolutely necessary if the pleasures now enjoyed by the hunters shall continue without curtailment. It is not logical to expect that the cattlemen will continue to accept the losses and inconveniences caused by hunters, which, from their point of view, are entirely unnecessary and unjustified, without a very serious protest. The tension can be greatly relieved by the cooperation of the hunters themselves. Remember the things on the back of the hunting license. Let the hunter put himself in the position of the cattleman, then practice the Golden Rule, and the hunter will be able to enjoy his hunting privileges for a much longer time than if some other policy is followed.

POSTED PROPERTY AND A SOLUTION OF THE HUNTING PROBLEM.*

By Captain Frank Winch.

Rod and gun clubs dot the horizon of America, and their name is legion. Ordinarily, their tenure of life can be measured in inches on the yardstick of time. A few fellows get together and decide to create a club. Officers are elected, an assessment is levied to give the right tone and color to the treasury. The layout, then, from the average angle, is complete. For the next six months or so, the club functions after a fashion. Then happens the inevitable. One member drops out, then another, and more until only a few of the standbys, honest-to-goodness-gun-cranks, encircle the bewildered secretary and ask "what's the matter?" The answer not forthcoming, more guns desert the locker, and in the finality we find the remnants of So and So Rod and Gun Club only a shattered wreck of hopes, the sign comes down and the whole thing is cobwebbed in reminiscence.

Why?

To my mind, the crux of the situation lies in the fact that we build our structure from the top in place of starting at the bottom. We overlook a fundamental without which no club ever has been or ever will be successful. We make every preparation for the hunt in the matter of clothes and sporting impediments, but we contribute to a fateful negligence when we are remiss on the subject, "How to Hunt Posted Property."

Every sportsman who has gone afield has had the solution of this situation at hand. We have had the posted property thing thrust at us, glaringly, and impressively on every milestone of our journey. Once solve the question of hunting posted property and you have rendered to the *n*th degree of simplicity the successful career of your rod and gun club.

Posted signs are more generously sprinkled about than the stars in the milky way, and the tendency seems to be headed toward trespass warnings on what little ground has been overlooked. There are certain states where it is impossible for the stranger to hunt unless he places himself in the middle of the public highway and risks a shot between

*From Sacramento Union, January 29, 1922.

glares of the observant farmer on either side of the fence. Reducing the problem to its elementals, you will find that the farmowner and the landowner is the barrier that stands between your club's success or failure.

Right here permit me to emphasize a point—the farmer and the landowner have found ample justification in posting their property. Broken fences, undone gates, injured stock and in many instances depredations and vandalism as surprising as they have been costly, sponsor the attitude of the farmer in keeping city sportsmen from his domain. Without a place to hunt and fish, without an interest by the hunter and angler in the propagation and conservation of game, without the good will of the farmer, the rod and gun club curls up and edges away from the necessity of existence.

The amelioration of this condition has engaged the attention of sportsmen for years. In isolated cases some good has been done, though the tendency has been a reaction which at best must be termed provincial.

The Eisner National Rod and Gun club plan appeals to me as being the soundest method of solving the sportsmen's dilemma. The objectives of the Eisner plan are to first, last and all the time recognize the farmer's rights as a sportsman and landowner; to seek the cooperation of the farmer by cooperating with him to protect his property; to assist him in securing game for propagation and see that in some manner he is reimbursed for the trouble; to share with the farmer the burden as well as the pleasure of hunting and fishing; to truly balance the administrative authority and manipulation of rod and gun club affairs by having in the directorate an equal number of farmers and city sportsmen; to work with the farmer to the end of securing such legislation as will work to his best interests and those of the majority; to encourage a spirit and morale of better sportsmanship, a closer observance of the game laws, to foster the effort to reduce hunting accidents; to emphasize a true regard for wild animal life and the necessity of game conservation.

These are the basic principles of the Eisner plan which starts at the beginning, right where it should, and this is the local unit of organization. The local club shall have as its officers a president, a vice president, secretary and treasurer and eleven directors, which shall be composed of five farmers, five city sportsmen and the deputy game warden. Membership is open to every farmer in the county and to all sportsmen who have been able to secure hunting licenses, and over these the club will eventually exercise control.

Each member is given a numbered card and at certain periods the farmer members receive bulletins giving the names, addresses and number of those belonging to the organization. The hunting grounds are posted with trespass signs issued under the seal of the national organization and none but members are permitted to enter these grounds and then only after announcing his name and number to the landowner, who shall hold the hunter responsible for any damage done to the property on the day so occupied.

Should a complaint be lodged against any member for damage or the violation of the game laws, the offending member is summoned to appear before the directors and the deputy game warden will act as

chairman for the hearing. The number of clubs in any county shall be restricted; each club, however, takes its name from the city, town, or village in which it is organized. From each club in the county is selected two members, one a farmer and the other a city sportsman who do not hold office in the local organization. These two men will represent their unit by acting as directors of the state organization, composed of all the clubs in that state.

The principal other officer of the state organization will be a secretary and his office shall be located at the state capital, where he may keep in touch with the legislators and be in a position to promote such legislation as the membership body may deem necessary. The state associations in turn will form the National Federation of Rod and Gun Clubs of America, the main officers of which will be two directors from each state, one a farmer and one a city sportsman, with the national secretary maintaining an office in Washington, where close cooperation can be given the federal authorities on all matters pertaining to hunting and fishing.

The policies outlined can be broadened in scope and should be, to include reforestation problems and the dissemination of valuable educational information along with the repopulation of waste land with wild animal life. These are the problems that the national organization could and would take hold of with a giant's grip. This done we arrive at the solution of how to "Hunt Posted Property."

CALIFORNIA FISH AND GAME

A publication devoted to the conservation of wild life and published quarterly by the California State Fish and Game Commission.

Sent free to citizens of the State of California. Offered in exchange for ornithological, mammalogical and similar periodicals.

The articles published in CALIFORNIA FISH AND GAME are not copyrighted and may be reproduced in other periodicals, provided due credit is given the California Fish and Game Commission. Editors of newspapers and periodicals are invited to make use of pertinent material.

All material for publication should be sent to **H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.**

AUGUST 1, 1922.

"Bag limits are crude and subject to great variability. If you halve the bag limit and triple the number of hunters in a given decade, you are still drawing on your principal, whereas the number of game refuges and consequently the breeding stock can be steadily increased in proportion to the demand for game."—(Bulletin Amer. Game Prot. Assoc., Oct., 1921.)

UNITED STATES FOREST SERVICE REPORT ON GAME CONDITIONS.

An agreement between the United States Forest Service and the California Fish and Game Commission, entered into in 1920, provides that the Forest Service shall report annually to the Commission game conditions within the national forests of the state. This report for 1921 contains a mass of valuable data relative to fish and game. The more important recommendations of forest officers include additional game refuges and enlargement of several of those already established; reduction of the bag limit on deer; the need of more reliable information on the number of deer in each particular locality, and particularly the number of bucks killed annually; and the need for additional game wardens to improve law enforcement.

The report shows that sage hens have been so reduced in Mono and Inyo counties that a closed season is recommended. Tree squirrels in southern California are becoming so rare that a closed season for a term of years is becoming almost a necessity. The toll taken of mule deer in Lassen and Modoc counties threatens the extinction of this species and better protection must be given it if a sufficient breeding stock is to be maintained. As in past years, the report on grouse is rather discouraging. This bird, although seldom hunted, is hardly holding it own through most of the mountain districts. Encouraging reports are made on the increase of the few bands of elk to be found within the national forests and the report on mountain sheep and antelope is also encouraging.

Tables give an estimate of the number of big game animals within the national forests of the state. The estimated total of deer is given as 184,785, and the reported kill for 1921 within the forests as 7,067. The estimated number of elk is 79; that of mountain sheep is 775, the latter being a very pleasing total.

Another table shows that forest officers, during the calendar year of 1921, prosecuted 66 cases for violation of fish and game laws, the fines amounting to $2,745.

GAME REFUGES POPULAR.

Judging by the increased demand for new refuges and for an extension of the boundaries of those already established, it is quite evident that in the eyes of the public the game refuge is popular and has justified its place as a conservation measure.

Where deer concentrate in certain areas during the hunting season a large toll is taken by hunters. There is no more satisfactory means of reducing this toll than to set aside an area as a game refuge and such a recommendation usually follows. This would at first appear to make deer harder to find and hunting more difficult. As it works out, however, the safety of the breeding stock within the area causes an increase which spreads out to the surrounding territory, furnishing better hunting. Many deer hunters are ready to testify that hunting has improved in the areas near the big game refuges.

There is a tendency, due to the popularity of the refuges, to demand the setting aside of numerous large areas. Should the demand continue, there is danger of usurping too much of the hunting ground and causing a reaction and change in sentiment that would perhaps destroy many of the refuges now in existence. It would seem best to proceed cautiously and to select with care a few out of the many recommendations for new refuges.

THE HUNTER AND THE LANDOWNER.

Oftentimes, from the standpoint of the landowner, the hunter is no respecter of property, and consequently is not to be tolerated. "Why must I raise deer and

quail for these city sports that come out hunting on my land, breaking down my fences, leaving my gates open, and carelessly killing my livestock?" is the usual plaint. That there is some justification for this viewpoint must be admitted. In recent years, hunters are finding the law of trespass more closely enforced and they are coming to their senses with the result that the hunters themselves in many parts of the country are carrying on an educational campaign to make the farmers rights better respected. In some instances, rod and gun clubs and fish and game protective associations have gone so far as to put up signs offering rewards for information leading to the arrest and conviction of anyone damaging the property of another while in the pursuit of game. Adherence to such rules as the following are advocated:

1. Respect the rights of the owner of this property; he is a good fellow or it would be posted.
2. Make good any damage you do, and report that done by others. You may want to come again.
3. Don't throw away a lighted match, cigar or cigarette. Aid in fire prevention.
4. Obey and assist in enforcement of fish and game laws of the commonwealth. Notify nearest game warden of violations.
5. There are two kinds of sportsmen: the regular guy and the piker. Where do you fit? It is a decided compliment to be known in your community as a clean sportsman.

Certain it is that the future privileges to the man who hunts or fishes depend upon the actions of the men who take the field today. In some way there must be worked out a closer cooperation between the landowner and the man who hunts if wide open fishing and hunting is to continue, and the usual "get out" of the landowner becomes an obsolete expression.

STRIPED BASS SCARCE IN NEW YORK.

The editor of the fishing and hunting section of the "New York Evening Mail" points out that the 1920 season's catch of striped bass for the State of New York was only 24,437 pounds. The catch in California during the same period amounted to 671,731 pounds.

The original stock of striped bass used for introducing this fish into California waters came from the neighboring state of New Jersey. The first introduction was made in 1879 with fish from the Neversink River, and a second introduction was made in 1882 from fish taken in the Shrewsbury River. From a state with no striped bass, California has come to be a state with a much better supply than that to be found at present in eastern states from which our original supply was taken.

Doubtless protective measures are largely responsible for the continued supply of this splendid food and game fish. As early as 1889 it was feared that the recently introduced striped bass were being exterminated before they had come to maturity and had a chance to reproduce. A county ordinance in San Francisco was accordingly passed, prohibiting the sale of striped bass under eight pounds in weight. Laws now provide against the shipment of striped bass out of the state; prohibit the sale or shipment of striped bass less than three pounds in weight; the sale of striped bass of over ten pounds in weight between April 1 and May 31; the sale of striped bass of any size between June 1 and July 31, or between September 17 and November 14; the taking or having in possession at any time of any striped bass of less than twelve inches in length; the taking within District 2 of more than five striped bass per day; the taking of striped bass between one hour after sunset or one hour before sunrise, or in nets on Saturday and Sunday, and the use of nets with a mesh smaller than five and one-half inches. Besides this, fully 1000 miles of sloughs in the San Francisco Bay region have been closed to commercial striped bass fishing. As a concession to the angler, a person may have in his possession, in any one calendar day, not to exceed five striped bass, between twelve inches in length and three pounds in weight; but such striped bass must be caught only with hook and line and must not be bought, sold or offered for sale.

It can be seen, therefore, that careful protection has been given striped bass in California, in fact, greater protection than has been afforded in eastern states. Protection of spawning fish, closed seasons, size limit and limited sale, all contribute to the safeguarding of this valuable fish.

POND FISH FURNISH MANY EGGS.

A splendid system of breeding ponds has been maintained for many years at the Mount Shasta Hatchery. A fine supply of trout eggs is annually obtained from these brood fish. This season a total of 8,000,000 eggs was secured. The importance of this steady supply is apparent during such seasons as the past winter

when spawning operations have been made very difficult by the heavy snows and the high water. In many instances the water has continued to overflow the racks, and in some cases the racks have been completely washed out, so that they had to be replaced. Such difficulties, combined with that of deep snow, makes spawn taking uncertain.

It is quite apparent that if the pond systems of our hatcheries could be tripled, a dependable supply would be assured, despite adverse weather conditions.

COUNTY USE OF LICENSE FEES.

Almost every sportsmen's organization formed in the state comes to the decision that its particular county is being unfairly treated and that it is not receiving patrol and fish for planting equivalent to the number of license fees paid into the preservation fund from that particular county.

Patrol and fish distribution is allotted as equitably as is possible. If fish and patrol service were distributed according to license fees, the counties with the larger cities would use practically all of the funds, and certain counties, where people spend their vacations, would receive no fish for planting and no patrol service. Alpine county, for instance, has a population of a few hundred, whereas residents of other counties annually use the fish and game resources. Certainly it is apparent that the present system is far more dependable than any distribution of fish according to counties.

GRAZING ENDANGERS GAME REFUGES.

A visit to many of the state game refuges will show that game is not receiving adequate protection, due to the destruction of food supply by cattle and sheep. Food supply is one of the most important factors concerned in the welfare of any species and the grazing of cattle and sheep in the refuge means a lessened food supply for game. Those conversant with conditions maintain that the disappearance of grouse in the higher mountains is due largely to the pasturing of sheep. Sheep are taken to the high mountain meadows at just the time when the grouse are nesting and the nests are trampled out and the grass cropped so clean that even a food supply for these birds is largely destroyed. Recent reports from Game Refuge 1D in Trinity County indicate that so many cattle are allowed to feed within this refuge that browse has become very scarce for deer. Any area will support only the number of big game animals for which there is an adequate food supply. A diminished food supply means a diminished number of deer.

Unless more attention is paid to the improvement of grazing inside game refuges, these areas will not be performing the service for which they were set aside. Undoubtedly cattle men and sheep men will oppose any restriction of grazing but there should be sufficient public sentiment to successfully close to grazing at least portions of each game refuge.

CRAPPIE FISHING IMPROVES NEAR SACRAMENTO.

The crappie appears to be taking the place of the Sacramento perch near Sacramento. This species seems to become more abundant from year to year, and every week-end and holiday sees hundreds of men and boys angling for this splendid game fish.

The crappie takes the fly readily and is easily caught on a spinner. Anglers maintain that the crappie compares favorably with the black bass as a pan fish.

THE UNAPPRECIATED SHAD.

The market for shad continues so poor that fishermen are tempted to throw back into the water all of the buck shad secured in their nets. Fishermen have been receiving but two cents per pound for buck shad and it retails for about six cents. Roe shad have a somewhat greater demand, but after the roe has been taken from the fish, it has but small value. In eastern cities the public is glad to pay 90 cents a pound for buck shad and anywhere from $1.25 to $1.50 for roe shad. Here in California at the height of the season one is able to obtain a good three-pound fish for about 25 cents, and yet there is no sale for it. Planked shad does not have the attraction for the Californian that is has for the Easterner. The person who can make shad popular in California can make his fortune. Someone ought to try placing filet of shad on the market to see if this would be more attractive than the fish in the round.

SEVERE WINTER HINDERS FISH-CULTURAL OPERATIONS.

The accompanying photographs from the Tahoe region should carry conviction that the fishcultural department encounters increased difficulties during severe winters. Most of our trout spawn very early in the spring and in the highest parts of the mountains. Access to such

FIG. 75. Mt. Tallac Hatchery, April 1, 1922, when spawning operations began in the Tallac region. Photograph by Jos. Sanders.

localities during February and March is often very difficult and yet the spawn-takers must reach the spawning stations before the run of fish is over. This often necessitates covering many miles on snowshoes, and living and working for many weeks in situations comparable to the arctic regions. Often before the streams have been cleared of ice it is necessary to build racks and traps. The actual spawning of the fish must usually be accomplished with snow many feet in depth.

A successful take of eggs is dependent upon a group of men who forego many bodily comforts in order to reach the spawning grounds in time, and great credit is due these loyal workers.

FIG. 76. Domingo Springs Hatchery, as it appeared on the arrival of spawn. Taken on April 2, 1922. Cross marks roof of hatchery Photograph by J. W. Ricker.

PREDATORY ANIMALS DESTROYED.

"The latest report filed by Inspector Chas. G. Poole, in charge of the cooperative predatory animal service, conducted jointly by the Federal Bureau of Biological Survey and the California State Department of Agriculture, shows a grand total of 1447 animals taken during the nine-months period July 1, 1921, to April 30, 1922. The detailed list shows 1008 coyotes, 277 bobcats, 64 skunks, 41 raccoons, 37 foxes, 18 badgers and one bear. Signed statements of stockmen and farmers show an average decrease in losses of live stock and poultry amounting to 88½ per cent. It is estimated that only one out of every three poisoned coyotes is found, which would materially increase the foregoing figures."

To the sportsman taught to believe that predatory mammals have a very direct bearing on the abundance of game, this report should be very pleasing. To the conservationist who would save nature as near unspoiled as possible, such a report is disturbing. To the biologist interested in the interrelations of living animals, such a report emphasizes that difficult problem presented by man's interference in the "balance of nature" and the consequent disturbances which entail endless artificial control measures.

DEER REPORTED DYING IN SEVERAL SECTIONS OF STATE.

It is not unusual for reports of dead deer to come in from the coast range mountains from Sonoma County northward. A number of deer appear to die each year in this section of the state even when there is no evidence of such an epidemic as appeared in Trinity County a number of years ago. This spring, reports have come from such widely separated places as the Mount Hamilton region in Santa Clara County, and parts of Siskiyou County, that deer were dying in considerable numbers. The report from the Mount Hamilton district, made by Dr. W. H. Wright of the Lick Observatory, states that the deer appear mangey, with large white patches on the sides.

HEARINGS HELD ON USE OF FOOD FISH IN REDUCTION PLANTS.

During the week beginning April 10, hearings were held in San Pedro relative to a violation of the law which provides that canneries may use not more than 25 per cent of the monthly catch in reduction plants. At the last session of the legislature, legislation was provided designed to prevent the use of food fish for the manufacture of fish oil and fish meal. In recent years each cannery has erected reduction plants in order to utilize the waste from the plant. As there was a tendency because of the demand for fish meal and fish oil, to utilize many sardines and other fish suitable for food, it seemed best to legislate against such a practice. The law prohibits the use of food fish in reduction plants, but provides that after a hearing permission may be obtained from the Fish and Game Commission to make use of unavoidable excess catches when no other market is available, the amount so used, however, in no case to exceed 25 per cent of the catch for the month. On January 11, 1922, the Fish and Game Commission issued an order stipulating that the catching of fish for use in a reduction plant would not be tolerated. During the past few months several canneries in southern California have failed to stay within the law and have apparently been evading the law and the regulations issued. As a consequence a complaint was filed and hearings have been held. The hearings have clearly shown that these canneries violated the law during the month of February. The penalty provided by law is a suspension of the license to operate for a period not to exceed 90 days. As the sardine season is over and will not be resumed for several months, and as each of the canneries will begin the canning of albacore and tuna in June or July, it has been decided to impose the maximum penalty in order that it may mean something. A suspension of the license for 90 days will keep some of the canneries closed during the early part of the albacore season.

VIOLATORS HEAVILY FINED.

A. Russo and five Italian fishermen were arrested by Deputy Burke at Visitacion Valley on three charges: (1) Fishing in District 3; (2) Using an illegal net; (3) Possession of striped bass. The case was tried before Judge Griffin of Redwood City on April 6, and Mr. Russo, who is an old violator, was fined $250 on the first charge and given 100 days in jail. Four of the other fishermen were fined $100 each, making a total of $650 in fines. The fifth fisherman, who was an old man of sixty-nine years, was dismissed.

THE RURALIST'S ATTITUDE ON HUNTING.

Everyone who talks to residents in the less settled portions of the state soon finds that their attitude on game laws is

quite different from that held by the city dweller. The point usually made is that since the owner of the land provides food and shelter for game, the landowner should have a right to utilize it for food. The point is always made that the city sportsman comes out into the country and kills his limit of deer, all of which he is not able to use, and consequently, almost invariably leaves venison to spoil in the woods. On the other hand, the resident of the hunting section maintains that he takes a deer when it is needed for food and utilizes the whole animal. Anyone who studies this situation must in fairness agree that the rural resident really has foundation for his attitude. Had city sportsmen properly conducted themselves, this point of view would have much less foundation, for, in America, game does not belong to the owner of the land but to all the citizens of the commonwealth.

THE GAME OF THE SMALL BOY.

Small game is not altogether the quarry of the boy hunter. Many men turn their attention to small game when unable to take the journey necessary to reach big game. Probably several times more rabbits are killed in California than all the big game put together. Originally the stock of rabbits was so great that it seemed almost impossible that the hunter could make any impression on their numbers. At the present time we find interest sufficient to support a closed season throughout the state, in spite of the oft-repeated accusation that rabbits are destructive to growing crops. In southern California, where rabbits cause more damage, sentiment is not so favorable to the closed season.

One state in the Union, having used up its supply of rabbits, has been paying thousands of dollars to secure specimens for restocking. Whether California will ever find herself in a similar situation we can not say, but now is the time to look to the future and see that a sufficient breeding stock is saved annually to provide food and sport for the small boy and the local sportsman. The comparative abundance of small game is likely to lead sportsmen to center attention on big game and forget the needs of the quarry of the boy hunter and the farmer.

"MACHINE GUNS VERSUS SEA LIONS."

A paragraph with the above heading appeared in a recent number of the Fish Trades Gazette (Organ of the National Sea Fisheries Protective Association, London) as follows: "The Canadian Department of Fisheries intends to wage an active campaign this summer against the hair seal and the sea lion—the principal enemies of the salmon, says the "Times Trade Supplement." The seals will be attacked in their rookeries off the Queen Charlotte Islands and the west coast of Vancouver Island. Machine guns and rifles will be used, the main effort being to exterminate the young of the sea lions. In past years hair seals have done great damage among the salmon. At one time bounties were offered for them, but of late years this practice has been discontinued."

The economy of thinning out or exterminating the seals and sea lions on the Canadian coast need not here be discussed, for surely the responsibility for such action would not lightly be taken without a thorough inquiry and analysis of conditions. If the sea lions have increased until they are a menace to the fisheries, a reduction may well be undertaken, but the reduction should be under complete and exact control.

The method proposed may be open to considerable criticism. It seems wasteful, unnecessarily cruel, to lack control, and especially to be without provision for knowing exactly the number of sea lions killed each year.

Machine gun fire into a mass of sea lions can not help but result in wounding many of them, leaving them to suffer A shot sea lion will use its last strength in plunging into the sea where it at once sinks. Unless shot through the brain, spinal cord or heart it will have life enough to do this, and many will be wounded in parts that are essential to life but may not lead to fatal results for several days. The interval can not be contemplated with any pleasure.

Each female killed before its young can find food for itself will mean the slow starvation of the young. On the California coast the sea lion nurses its young nearly up to the time the next young is born. In Alaska the nursing season is apparently shorter. Just at what age the young could shift for itself is not known. Probably it could obtain solid food within a few months of its birth, but surely not at a time when it is still on the rookery in numbers, which would be the most profitable time for machine-gun fire. To be sure, there is a time in the breeding season, when the young are a few weeks old, that the adults may be driven from the rookery, and the young only may then be the re-

cipients of the rain of bullets, but there are surer, more merciful methods than such a hit-or-miss one, if the rookery can be landed upon. The death of each female means the starvation of its young, because by no possibility will a female allow any but its own young to nurse.

The method is wasteful because the skins may be made of commercial use, if a number can be obtained at one time, or if the supply is at all regular. The coast would doubtless yield several hundred skins each year.

Numbers among the sea lions can be easily and exactly controlled by the death of the young. Firearms of any kind are not necessary. The young do not leave the rookery until they are 5 to 6 weeks old, and a man with a club could land on a rookery and kill 500 in a day. This method would be humane, and doubtless would be at least profitable enough to make the sea lion controlling body self-supporting. By such a method a definite number could be killed each year and the result watched that there may be no danger of complete extermination.

Of course some rookeries could not be landed upon at any time, and that is probably the reason for the suggested machine-gun method of control.

That this method would be efficient is well shown by the black, or California, sea lion the young of which was hunted by sealers on the rookeries so that within a short time that species was so reduced in numbers that extermination was feared. It is now protected on the Santa Barbara Islands, where it breeds.

Mr. C. H. Townsend wrote a paper on "The Utilization of the Sea Lion (Zool. Soc. Bull., Mar., 1919), in which he advocates the killing of the young, as is done in the Newfoundland seal fishery. If some of our California rookeries continue to increase in size (as the Ano Nuevo Island rookery apparently is doing), especially if it can be shown that the increase is not just local, but of the entire coast, this herd may have to be kept within a reasonable size by some such method as that here considered.—EDWIN C. STARKS, Stanford University, California.

THE COST OF LAW ENFORCEMENT.

According to statistics compiled by the Indiana Department of Conservation: the cost to the State of New York for each of the 4090 convictions last year amounted to $79.57. The State of Missouri, with about one-sixth the number of salaried wardens, paid $671.04 for each conviction. The later amount even exceeds the cost in western states, where vast areas of big game country must be patrolled by a single man, and convictions are necessarily few and far between.

PRINCIPLES OF MANAGEMENT.

"In order properly to manage our wild life resources, particularly the fish and game, certain definite action is necessary. Protective measures, as well as methods to increase the production of fish and game, must be based on correct information regarding natural history. The public and particularly the sportsmen, must appreciate the reasons for such measures and provide a public sentiment that will demand their being carried out. The administration of the game department must be such as will sincerely strive to improve conditions and have the interests of the sportsman at heart.

"In this connection let me emphasize the necessity for the wild life enthusiast and the naturalist to recognize the great number of men who are just ordinary sportsmen. Working by himself the naturalist plays rather a lone hand but by active cooperation with the sportsmen he can give them much information they are anxious to obtain and can do considerable in encouraging better sportsmanship. In the end it is the attitude of the average man which governs the success of protective measures and it is through him that the greatest results can be obtained."—S. E. LOCKE, Ogden, Utah.

HANDSOME GIFT FOR WILD LIFE PROTECTION.

The National Association of Audubon Societies has just received a cash donation of $200,000, the largest of numerous donations which through the years have been received from the same source. All the gifts of this friend of wild life have been made with the distinct understanding that the name of the donor be withheld. The recent check is to be known as the "Permanent Fund of 1922" and the interest is to be used along the lines of endeavor specified by the giver, which are as follows:

1. For the education of the general public in the knowledge and value of useful, beautiful and interesting forms of wild life, especially birds.

2. For the actual protection and perpetuation of such forms of wild life on suitable breeding and other reservations.

3. For protecting and maintaining adequate protection for such forms of wild life in all parts of the Western Hemisphere.

4. Or for any one of these purposes.

TWO GAME REFUGES RECOMMENDED FOR PLUMAS NATIONAL FOREST.

It has been roughly estimated by the Forest Service that there were approximately twenty-five thousand deer ranging in the Plumas National Forest in 1921. However, it has also been estimated that more deer were taken from Deer Creek Meadows and Dixie Valley in 1921 than in all the rest of the National Forest, showing that deer concentrate there each fall. It is now being strongly recommended that two new game refuges be established, one in the vicinity of Dixie Mountain, the summer range for the mule-tailed deer, and the other in the Deer Creek Meadows. The elimination of hunters from these areas would greatly reduce the annual toll. These refuges would also greatly benefit quail and grouse, since sheep would be excluded. Grazing sheep constitute one of the greatest menaces to nesting quail and grouse. —GEORGE W. CHAMBERLIN, Quincy, California.

GAME AS A NATIONAL RESOURCE.

The United States Department of Agriculture has rently issued a bulletin (No. 1049) by Dr. T. S. Palmer, expert in game conservation, on the subject of "Game as a National Resource." This bulletin discusses briefly the value of game as food and as an asset to the individual and to the state, reviews the various methods by which estimates of such values are obtained, and points out some of the causes of present depleted conditions and some of the methods by which game resources may be preserved and increased, together with the expense involved in work of this kind.

A few of the outstanding facts gleaned from this publication follow:

"Of the 19 states north of latitude 42 degrees and Mason and Dixon's line, 16 had deer hunting in 1920, the exceptions being Connecticut, Rhode Island and North Dakota. Of the 29 states south of this line, Delaware, Maryland, West Virginia and nine states in the corn belt had no deer hunting and Missouri had very little. The possible deer crop is more than twice as large in the northern tier as in the southern, the possible kill under normal conditions being respectively 60,000 as compared to 25,000. The only states to the south where the annual kill is likely to exceed 5000 are California and Texas.

"In a number of states serious inroads have been made in the breeding stock because until recently laws have permitted the killing of does. In New York in 1919, when the season was open on both bucks and does, probably more than one-third of the total number of deer in the state were killed.

"Elk formerly occurred and were hunted in nearly every state. Estimates made a few years ago showed a total of approximately 72,000 elk in the United States, whereas today it is doubtful if the number is much in excess of 52,000, of which about 25,000 are found in the Yellowstone National Park and adjoining regions. Elk hunting has been closed in most states and is now restricted to a few counties in Idaho, Montana and Wyoming, where the number is limited to one to each hunter.

"Rabbits probably constitute the largest, cheapest and most generally available supply of game in the United States. Abundant almost everywhere, shot for sport and market, and free from non-sale restrictions in many states, they form an important item of food supply. The jack rabbits in the West, which are a serious pest in some states, are destroyed in enormous numbers, but only a relatively small number are placed on the market and find their way to eastern states. Cottontails, however, are found in every state in the Union and during the autumn and winter are hunted almost everywhere. In 23 states there are close seasons and other regulations, but in the other states there is at present no restriction on hunting. These animals form a nutritious and relatively cheap meat, which is thus available to a considerable number of persons who can ill afford to pay high prices for beef, mutton and pork.

"Every state has some species of quail, either native or introduced. Probably no game except ducks is more generally hunted. The sale of native quail is now prohibited throughout the United States except in a few counties of North Carolina.

"The hunting license fees now required in most of the states constitute a comparatively modern source of income, dating back only to 1895.

"Of the various methods of increasing game resources which have been suggested or put into practice in the United States, four merit special notice, namely, protecting game, establishing refuges, restocking depleted areas, and breeding on game farms.

"Artificial game propagation is still in an experimental stage, and the kinds of birds which can be produced in large

numbers with any degree of certainty are at present very limited.

"In regulating seasons, certain principles are generally considered fundamentally important. Among these are the prohibition of summer shooting—that is, during the breeding season; the prohibition of spring shooting, while birds are on their way to the breeding grounds; and the protection of females of big game, particularly in the case of deer.

"The states which have the largest aggregate areas devoted to game refuges are California, Minnesota, and Wyoming; those which have the greatest number of individual refuges are probably Michigan and Pennsylvania.

"Two elements are essential for the success of any game refuge: First, permanency; and, second, sufficient area in a compact body. For the protection of big game, long narrow strips of territory are comparatively worthless and constantly shifting boundaries furnish little actual protection.

"No field of conservation is more important than the restoration of game in regions where it has been reduced to the vanishing point or completely exterminated. Plans for bringing back the game usually involve legislation, introduction, or propagation.

"The principal expense connected with the protection of game is the maintenance of a patrol adequate to prevent violations of the laws.

"Estimating the total amount of each kind of game in any state would make it possible, by revising and comparing the estimates from year to year, to tell whether the stock is increasing or whether the total number killed exceeds the annual increase."

That enumerations and valuations of the annual kill of game are not as yet stabilized is evidenced by the wide divergence of the valuation placed upon the various kinds of game. In the tables given, New York placed a valuation of $75.00 on each deer, whereas Virginia estimates the value of each deer at $26.00. It is to be hoped that some more uniform valuation may be determined upon in the near future.

CONSERVATION IN OTHER STATES.

MISSISSIPPI PLANS GAME LAWS.

Mississippi is one of the few remaining states that has no game laws or any organization to protect fish or game. The first sign of awakening is now at hand, however, for the Mississippi State Game and Fish Development League was recently organized at Vicksburg. This organization is backing attempted legislation in the Mississippi legislature.

LANDLOCKED SALMON PLANTED IN IDAHO.

The state of Idaho last year planted eastern landlocked salmon under ideal circumstances and plans to continue the introduction of this species during the next two seasons.

CONSERVATION IN MEXICO.

For some time it has been advocated that the United States Government enter into a treaty with Mexico for better protection of such of our migratory birds as winter in that country. Fortunately the Mexican Government is now showing an interest in the protection of wild life, and as a result that country is planning the passage and enforcement of the first game laws to be enacted in Mexico. In furtherance of this plan the Mexican Department of the Interior recently sent Mr. Delfino P. Cedro to the United States to study our methods of conservation, our laws and their enforcement.

UNITED STATES FOREST SERVICE COOPERATION.

PAUL G. REDDINGTON, Editor.

ELK INCREASE ON CLEVELAND NATIONAL FOREST.

One calf elk was reported in the band of 12 liberated in the Laguna Mountains in 1919. Seven of these elk located near the Laguna Recreation Area and are apparently in good condition. The other five drifted to the lower elevations along the desert slopes and not much is known as to their present number or condition.

GAME CONDITIONS ON THE ANGELES NATIONAL FOREST.

It is estimated that about 160 mountain sheep within the forest are principally in the San Antone and Twin Peaks country in refuges 4A and 4B. On the Forest outside of the refuges very little hunting is done as the deer immediately go into the refuges soon after the opening of the hunting season. Even in the refuges deer are not as plentiful as they should be considering the length of time they have been protected. Deer are found in greater numbers around the more frequented locations than in the more remote portions of the refuge. This is attributed to mountain lions being more plentiful in the less frequented areas. It is also reported that the mountain sheep have not increased to any extent in the past seven years on account of mountain lions and the work of poachers. Several sheep carcasses partly devoured have been found.

A FEW ANTELOPE LEFT IN SOUTHERN CALIFORNIA.

Antelope may still be found along the foothills of the Tehachapi Range and in Antelope Valley on the Santa Barbara Forest where there are at least 10.

INTRODUCED ELK THRIVE ON SEQUOIA NATIONAL FOREST.

A few elk are reported on the Sequoia Forest. It is believed they drifted from the Sequoia National Park. There were some Buttonwillow elk placed in the Kaweah country several years ago. A stockman reported seeing two yearling elk last summer, which indicates the herd is increasing.

MOUNTAIN SHEEP ON THE INYO NATIONAL FOREST.

It is estimated there is a total of 365 mountain sheep on the Inyo Forest. They are found principally on Wyman Creek, Waucobe Canyon and Piute Mountain, Goldale and Birch Mountains, Pine and Rock Creeks. They seem to be slowly increasing through the protection afforded by a closed season and a close compliance with the game laws.

GAME INTRODUCED ON THE MONO NATIONAL FOREST.

Carson Valley sportsmen are taking an active interest in game propagation and protection and have introduced ring-necked pheasants, bobwhite and Gambel's quail. The ranchers in this locality take especial care in feeding these birds during heavy snow.

MANY DEER KILLED ON LASSEN NATIONAL FOREST.

It is believed about 5000 hunters visited he Lassen Forest the past hunting season, and that 450 deer were killed. The mule-tail deer on this Forest are reported as rapidly decreasing. During the war period there were relatively few hunters and this species of deer rapidly increased. However, with the tremendous increase in the number of hunters since the war, it is believed this species of deer is in danger of extinction.

MULE DEER IN DANGER OF EXTERMINATION.

The Columbian blacktail and the mule deer are both found on the Shasta National Forest. It is estimated that there are 12,000 of the former and 1000 of the latter, or a total of 13,000. The mule deer are largely found in the northeastern part of the Forest within and adjacent to the lava bed country. It is estimated that a total of 427 deer were killed by hunters during the past season, of which 134 were mule deer. This is an increase of over 43 per cent over last year in the number killed of this species, there being only 76 killed during the season of 1920. There was a large increase in the number of hunters in the mule deer country last year.

ELK ON THE SHASTA NATIONAL FOREST.

Several years ago the Elk Lodge at Redding shipped 50 elk from the Yellowstone Park and placed them on this Forest. About half the number died soon after they were liberated. The remainder have increased up to about 60 head and are now located on Brock, Lick and Flat creeks and on Brock Mountain. Last year several calves were seen. It is believed this herd has now become permanently established and will continue to increase in numbers.

MODOC COUNTY PAYS BOUNTY ON COYOTES.

Last year Modoc County paid bounty on almost a thousand coyotes, many others being killed upon which the bounty was not collected. While coyotes prey chiefly upon domestic stock in this locality, it is known that they kill a great many deer on the Modoc National Forest.

ELK ON THE KLAMATH NATIONAL FOREST.

There is a band of seven elk on the Scott River District of the Klamath Forest. While this is only an increase of two over the number reported last year, it is believed these elk are now doing well and will increase in numbers more rapidly in future years.

TRINITY COUNTY PAYS BOUNTY ON COYOTES.

During the past few months local hunters with dogs have killed 10 mountain lions in and around game refuge 1D situated within the Trinity National Forest. Trinity County has been paying a $3 bounty on coyotes for the past several years and from 1908 to 1921, inclusive, has paid out a total of $11,992 in bounties.

CALIFORNIA FOREST HAS BIGGEST RECORD OF DEER KILLED.

During the hunting season of 1920 a record of 1200 bucks killed by hunters was obtained by Forest officers of the California National Forest. It is safe to assume that this does not cover half of the deer killed, which would probably total 3000. The great majority of bucks taken are forked horns, and it is a common statement by hunters that larger bucks are much scarcer than formerly. This is in all likelihood due to the great increase in hunting, for during the last ten years the number of visitors to this Forest has easily increased six times, and is conservatively estimated at 6000 for the season of 1921. Three-fourths of this number visited that portion of the Forest included within Game District 2, which has the early opening date of August 1.

VIOLATIONS OF FISH AND GAME LAWS,

January 1, 1922, to March 31, 1922.

Offense	Number of arrests	Fines imposed
GAME.		
Hunting without a license	12	$165 00
Hunting in game refuges	2	20 00
Hunting in posted grounds	2	20 00
Night hunting	1	25 00
Trapping without a license	3	30 60
Making false statement to secure hunting license	1	40 00
Birds, non-game; possession, killing	4	170 00
Deer, possession, killing, closed season	7	195 00
Does, possession and killing	6	300 00
Deer meat, possession, closed season	12	360 00
Ducks, possession, killing, shipping, closed season, over-limit	14	400 00
Gallinule, possession and killing	1	25 00
Geese, closed season, over-limit	3	50 00
Pheasants (wild), killing and possession	4	250 00
Pigeons, possession	1	25 00
Rabbits, possession, killing, without license	6	125 00
Robins, possession and killing	10	121 00
Shore-birds, killing	1	25 00
Squirrels, possession, killing, closed season	4	25 00
Quail, possession, killing, closed season	2	100 00
Shooting before half-hour before sunrise	2	50 00
Shooting after half-hour before sunset	1	25 00
Hides, possession, illegal	5	
Total game violations	104	$2,546 00
FISH.		
Fishing without a license	4	$40 00
Fishing in District No. 2	2	
Abalones	12	325 00
Barracuda	11	775 00
Bass	5	140 00
Clams	21	630 00
Crabs	9	145 00
Halibut	3	200 00
Lobsters	6	145 00
Salmon	1	100 00
Sturgeon	2	20 00
Trout	12	320 00
Catching young smelt	5	25 00
Spearing steelhead above tide waters	1	100 00
Using net more than six feet in District No. 2	1	
Using net more than six feet in District No. 3	1	100 00
Using three-inch mesh net in District No. 12	1	100 00
Using gill net less than 5½-inch mesh for bass	2	100 00
Depositing petroleum in San Francisco Bay	1	200 00
Totals	100	$3,465 00
Grand total fish and game violations	204	$6,011 00

SEIZURES.

Game.		Fish.	
Deer	1	Abalone	139
Deer head	1	Abalone	612 pounds
Deer meat	105¾ pounds	Abalone	90 boxes
Ducks	1,113	Bass	60
Elk	50 pounds	Striped bass	119
Fawn	1	Striped bass	70 pounds
Geese	64	Striped bass	1 box
Grouse	2	Barracuda	124
Killdeer	4	Barracuda	8,169 pounds
Meadow lark	1	Clams	543
Prairie chickens	2	Crabs	1,465
Quail	38	Lobsters	120
Rabbits	16	Lobsters	50 pounds
Robins	14	Lobsters	88 boxes
Squirrel	1	Halibut	1,825 pounds
Wild pheasants	4	Salmon	3
Skins	9	Salmon	90 pounds
		Shad	1
		Smelt	479 pounds
		Sturgeon	11 pounds
		Trout	5
		Steelhead trout	219 pounds
		Steelhead trout	4 boxes
		Illegal net	3
		Searches	15

CALIFORNIA FRESH FISHERY PRODUCTS FOR MONTHS OF JANUARY, FEBRUARY AND MARCH, 1922.

Compiled by Fish and Game Commission, Department of Commercial Fisheries.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Glenn, Tehama, Colusa	Sacramento, San Joaquin	Contra Costa, Alameda	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	Imperial	San Diego	Total	Mexican, brought into California
Albacore												60,246				60,246	
Anchovies											24,080	490,078	145		191,632	705,935	780,065
Barracuda									113	13,772						13,885	
Bluefish								32,750	99,828	316,705	980					450,263	
Boccaccio												20,905			9,486	30,391	23,916
Bonito		1,700		1,488		5,016	11,220	38								19,462	
Carp		60,895				674										61,569	
Catfish								11,972	92,391	11,274						115 637	
Chilipepper								99,676	5,515	24,393		5			192	132,409	
Cultus Cod	2,332	296															
Dolphin																	
Eels																	
Flounders	12,801		25	192			380	127,957	11,316	705	191	100			120	153,787	120
Grayfish							50	51,592							68,940	120,582	
Greenfish																	
Hake								1,475								1,475	
Halibut								13,694	434	3,708	120,708	612,955	38,021		160,462	949,982	104,246
Hardhead						9,539	70,345									79,884	
Herring	5,937		170					206,446			517					213,070	
Kingfish								1,925	29,270	70,336	215	108,542			107	210,395	30
Mackerel										24,096	9,753	424,323	413		78,927	537,512	20,515
Marlin																	
Mullet														774	253	1,027	1,027
Perch	27,853	70	17,320				18	14,779	300	5,422	183	10,636	9		78	76,668	
Pike				58	153	1,196	1,074									2,481	
Pompano								1,350		63		1,047				2,460	
Rock Bass												18,347	932		2,908	22,187	1,896
Rockfish	2,086	1,417						204,827	59,978	159,118	33,357	558,378	880		166,758	1,186,799	20,691
Sablefish								80,893	16,149	1,497						98,539	
Salmon				31,538	38,014	25,444	48,746	223		10						143,975	
Sandabs								313,362	14,250	1,106		2,580				331,298	
Sardines										5,307,965	130	36,172,547			720,239	42,200,881	
Sculpin												13,608			714	14,322	181
Sea Bass—Black												8,446	177		6,573	15,196	6,293
Sea Bass—White	68		820							14	200	149.394	144		74,266	224,906	56,255
Sea Trout	65											277	93		263	698	
Shad				613		2,243	10.904	734								14,494	
Shad—Buck				2,529		2,011	13,445	15								18,000	
Shad—Roe				5,463		1,362	13,467									20,692	

Sheepshead												157	1,130			4,992	6,279	
Skates								41,335	1,850	620	2,505	1,466	874				48,650	
Skipjack																		1,654
Smelt	5,371		2,738				13,356	41,250	246	5,089	22,020	58,155	719			3,323	152,267	
Sole								1,633,593	19,840	11,455	19,595	58,544	1,495			6,328	1,750,850	
Splittail						8,375	7										8,382	
Striped Bass			160	25,020	270	19,686	71,739	7,031									123,906	
Stingaree																		
Suckers						1,100	4										1,104	
Surf Fish																		
Swordfish												105					105	
Tomcod								7,788	1,050								8,838	
Trout—Farm																		
Trout—Steelhead																		
Tuna												625				1,806	2,431	1,991
Tuna—Bluefin																		
Tuna—Yellowfin																		
Turbot			8														8	
Whitebait								386									386	
Whitefish												8,582				495	9,077	2,491
Yellowtail												96,010	760			51,922	148,692	269,092
Miscellaneous	2,482			75			351	7,834	14,196	5,424	35,311	10,633	476				76,782	433
Total fish	58,995	64,378	21,241	66,976	38,437	77,046	255,106	2,902,925	366,726	5,962,772	269,902	38,887,664	45,138	774	1,550,784		50,568,864	1,290,896
Crustaceans:																		
Crabs (doz.)	1,787	161	330				46	11,713	57	2							14,096	
Ecrevisse (doz.)																		
Shrimps			7,179					153,376			20,382						180,937	
Spiny Lobsters												44,426	2,093			50,508	97,027	420,417
Mollusks:																		
Abalones										198,990	960						199,950	6,265
Clams—Cockle	695		4,175														4,870	
Clams—Mixed	8,183		10,548								100	1,093					19,924	
Clams—Pismo									292		37,166						37,458	
Clams—Softshell		1,132	20,160				54,679	13,318									89,289	
Cuttlefish			22					4,147	5,119	21,602		405					31,295	
Limpets																		
Mussels							1,282	3,482	150	2,125							7,039	
Oysters—Eastern (No.)			1,105,511														1,105,511	
Oysters—Native																		
Snails																		
Squid										2,572		12,927				12,607	28,106	
Miscellaneous:																		
Frogs (doz.)																		
Terrapins (doz.)																		
Turtles																		110

All amounts shown in pounds unless otherwise specified. Albacore and Skipjack cleaned. All other fish in round.

19493 7-22 7M